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Customizing



In-car Entertainment



Easy Stereo Upgrades

Choosing Speakers

Add a Subwoofer

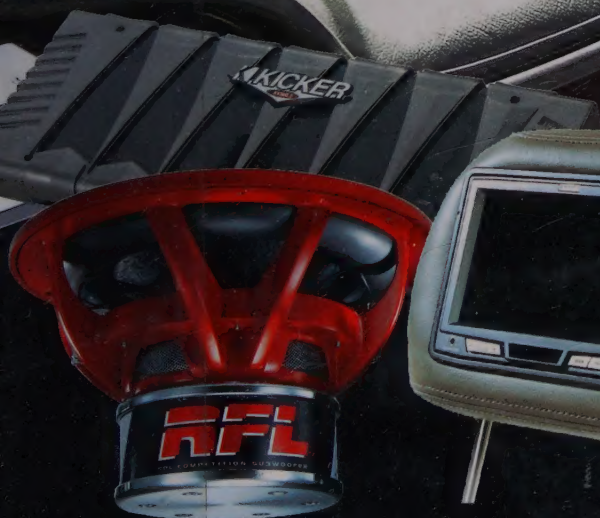
Custom Sound
Installations

The Latest CD and
Digital Players

All About
Satellite Radio

Mobile Video
Install monitors
Add a DVD

Install a
Navigation System



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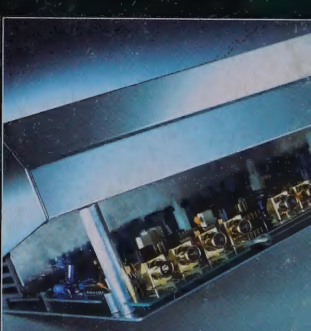
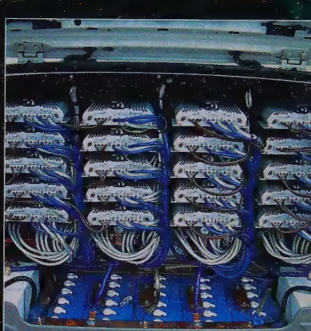
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Sparkford Nr Yeovil
Somerset BA22 7JJ
England

Haynes North America, Inc
861 Lawrence Drive
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California 91320 USA

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Be careful and know the law!

1 Advice on safety procedures and precautions is contained throughout this manual, and more specifically within the Safety section towards the back of this book. You are strongly recommended to note these comments, and to pay close attention to any instructions that may be given by the parts supplier.

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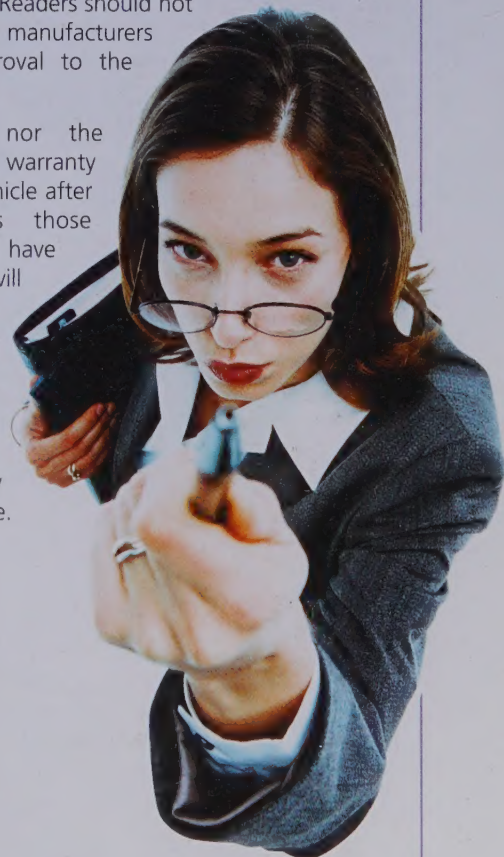
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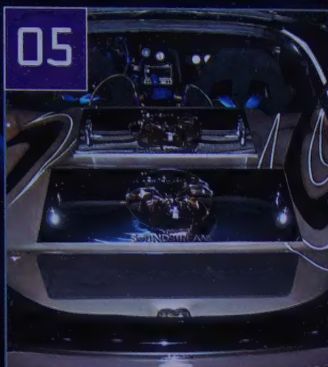


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01

Introduction

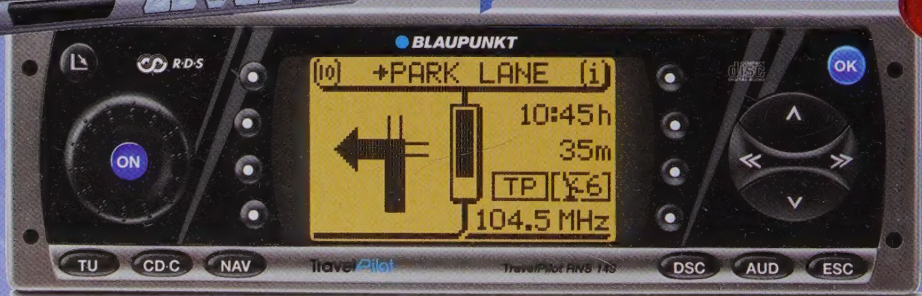


Not too long ago, the average automobile entertainment system consisted of an A.M. radio and a single speaker. Not anymore.

In the last few decades, more of the comforts of home are finding their way into the automobile. Don't expect to see an in-dash toaster anytime soon, but CD changers, MP3 players, video systems, surround sound systems and security systems have made it possible to turn your vehicle into your "home away from home."

Even some of the components that were once hidden away by installers, such as amplifiers and subwoofers, are now proudly mounted where they can be displayed. Part of the attraction is showing off this new equipment and the "installation handiwork" that went into it.

Fitting these various devices has also gotten easier due to the myriad installation kits now available, which has eliminated much of the custom fabrication that was once necessary. Most novices are able to install mobile electronic equipment on their own with a minimum of special tools. When carried out carefully and methodically, a professional-looking installation can be had by just about anyone with the required spare time on his or her hands.





Video

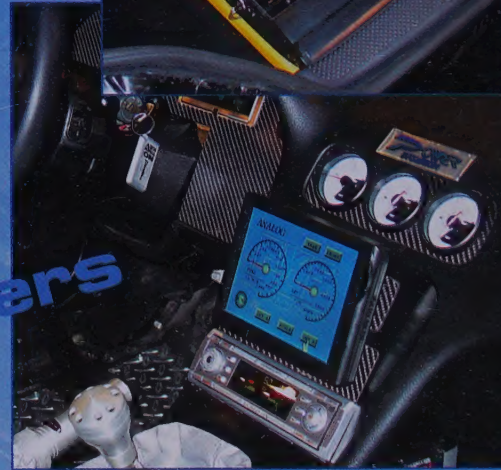
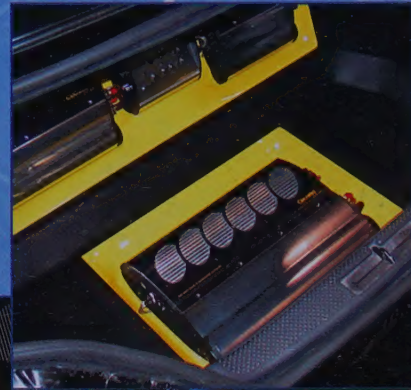
Security systems



So why bother upgrading your mobile entertainment? Because you spend a lot of time in your car - why not make it as pleasurable as possible. For most people, the daily commute represents about 1/2 hour each way. That's over 200 hours a year! And we're not counting weekend trips and vacations. So go ahead and add that amp and subwoofer. And that DVD player too; you deserve it! But do yourself a favor before you start spending some serious coin. Start by planning on exactly what you want from your system. Whether you're integrating with factory equipment or installing or replacing individual components, plan ahead carefully, do what you can do realistically, and don't break the bank!

Of course, not everyone will want all of the stuff described in this manual in their vehicle, and that's fine. Some will, and that's OK too, but it doesn't have to be done all at once.

Oh - with the addition of all this expensive stuff in your car or truck, you'll probably want to think seriously about a security system . . .



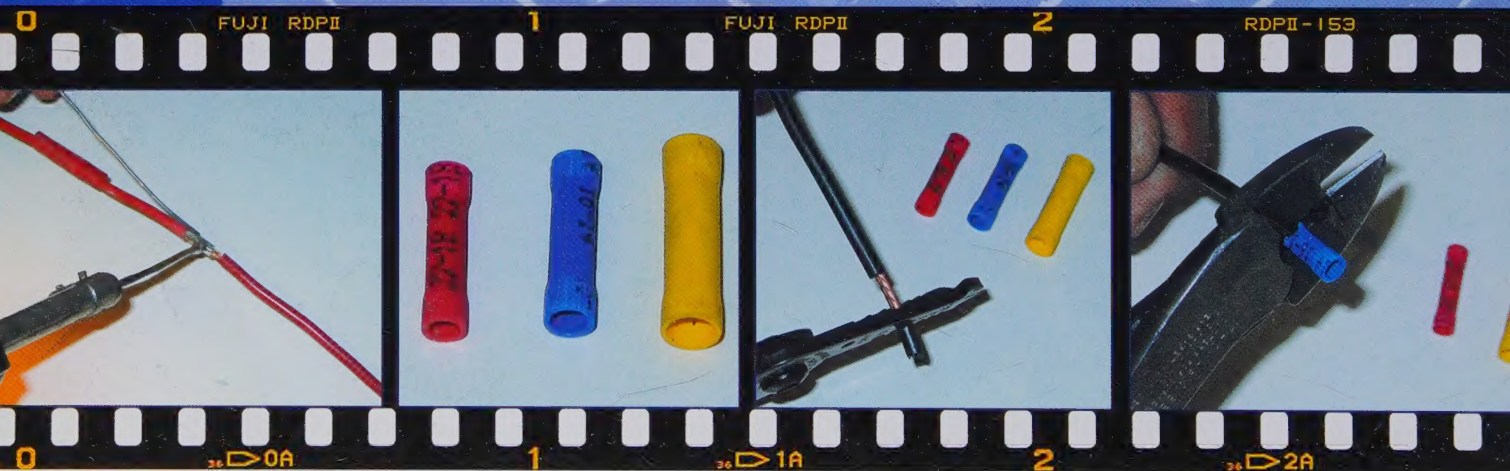
MP3 players



Speakers

Connections 101

Throughout this manual, we will be asking you to connect wires when installing various components. In other parts of the book, in particular the "Accessories and necessities" Chapter, we will discuss the various connection types, discussing when and why they are used in your installations. Here we'd like to give you the basics on making these connections. In general, soldering makes the best connection, and the connection is corrosion resistant when done correctly, so always solder connections used in areas that could be exposed to weather. Crimp and snap-splice connections are generally used inside the vehicle. These easy-to-make connections are sometimes the only option in areas (such as deep under the dash) where soldering is impractical.



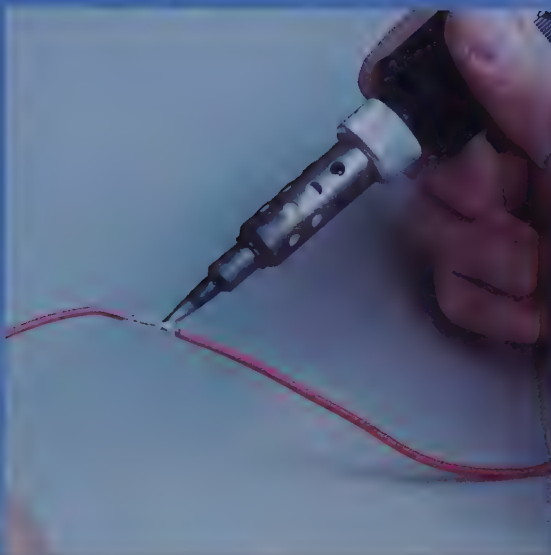


Solder a joint for the best connection, but if you've never soldered, you need to know how to do it. Heat shrink tubing should be used to insulate the joint after soldering (just be sure to slide it onto the wire before you start soldering or you won't be able to get it on afterwards)



Soldering

When you need to join two wires, strip the ends back far enough so you can twist them together for a strong connection



Solder should be applied so that it flows over the connection. Once the soldering iron is hot, the iron should be held below the wire while applying the solder from above. This allows the solder to flow from the top of the wire to the bottom more uniformly. A good solder joint should be smooth and shiny, not a big blob. It is important to remember that solder does not go from the liquid state directly to the solid state, but has a plastic state in between. During the plastic state, a "cold" solder joint can occur if the joint is moved (it'll become a dull gray, not shiny silver). A cold solder joint is not good enough because it will contain air bubbles and either break off or have a poor electrical connection

To finish things off, heat shrink tubing should cover the complete joint and with a quick blast of hot air on the heat shrink, a good insulated seal will protect the joint



Warning:

Whenever working on a vehicle equipped with an airbag (or airbags), be sure to disable the airbag system before working in the vicinity of any airbag system components. This is especially important when working around the instrument panel and center console. Consult the Haynes Automotive Repair Manual for your vehicle for the airbag disabling procedure. If no manual exists, consult a dealer service department or other qualified repair shop to obtain the information. Also, NEVER splice or tap into any wiring for the airbag system, and never use a test light or multimeter on airbag system wiring. On most vehicles the wiring for the airbag system is yellow, or is covered by yellow conduit, or at the very least will have yellow electrical connectors.



Crimp connectors



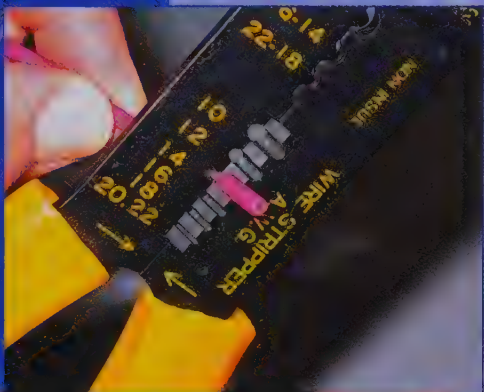
Introduction

There is a wide variety of crimp-type connectors available at auto parts stores, which will allow you to make virtually any type of connection you need to make. See "Accessories and necessities" for a discussion of the various types of connector ends available. To make the connections properly, you'll need to use a special crimping tool (available at most auto parts stores). Try to get a good-quality tool that presses an indentation into the connector. Some of the cheaper tools simply flatten the connector, which gives an inferior connection. Also, be sure you're using the correct connector type for the gauge of wire you're connecting.

If you don't know the wire gauge, you can figure it out using your crimping tool by inserting the end of the wire into each of the stripping holes in your crimper until you find the one that strips off the wire's insulation. If that doesn't work, just use whichever crimping hole that fits best. And always use the "pull test" to verify that your crimp is sound.

What if the wire on which you want to install a crimp connector is too small for the connector, or one of the wires you want to connect to another wire is too small for the butt connector that fits the larger wire gauge? Beef up the thinner wire by stripping off twice as much insulation as you normally would, then fold the wire back over itself and twist it together.

And if the wire on which you want to install a crimp connector is too large for the biggest crimp connector you've got handy? Then it's time to head to the nearest auto parts store for more crimp connectors! In other words, do NOT try to "cut down" the gauge of a stripped-off wire end in order to jam it into a too-small crimp connector. You will be creating a high-resistance hot spot in the circuit that will surely overheat and might even start a fire.



Crimp connectors are quick and easy to install - simply strip off about 1/4-inch of insulation using the proper-gauge hole on your stripping tool . . .

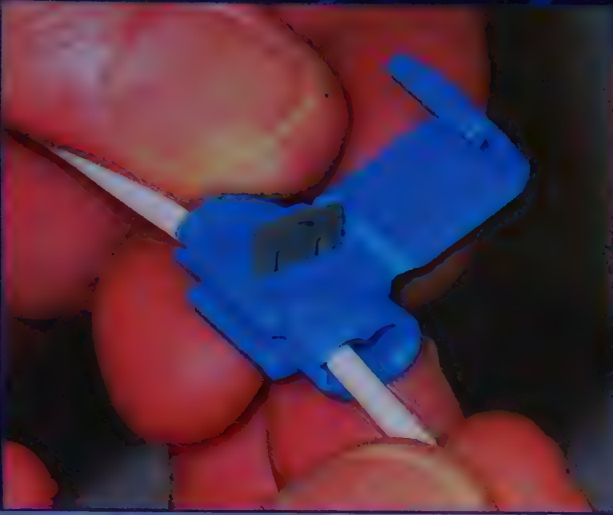
. . . insert the stripped wire and crimp the connector firmly onto it using the correct crimping jaws of the tool



Note:

When installing spade or bullet connectors, always crimp the female side of the connector to the feed wire. This way, if the connector comes unplugged, the "hot" wire won't short out if it touches a ground (it'll be shielded by the insulation surrounding the female side of the connector).

Wire gauge	Industry standard color on crimp connector
22 to 18	Red
16 to 14	Blue
12 to 10	Yellow



To use a quick-splice connector, pass the "tap" wire through the outer channel of the connector . . .

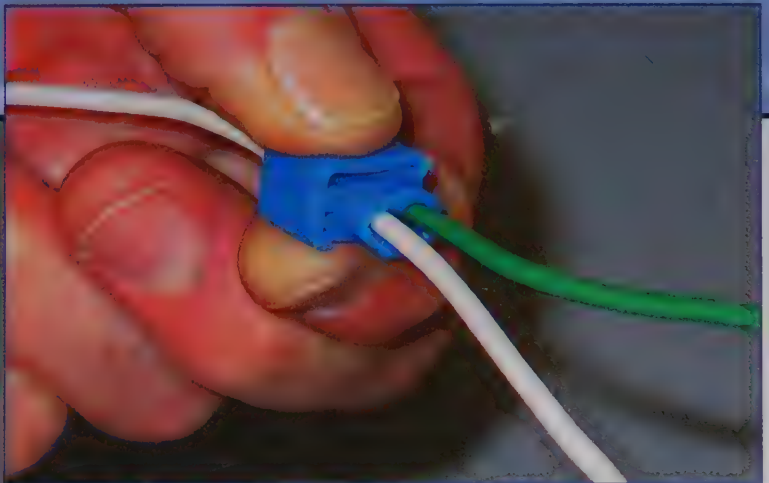
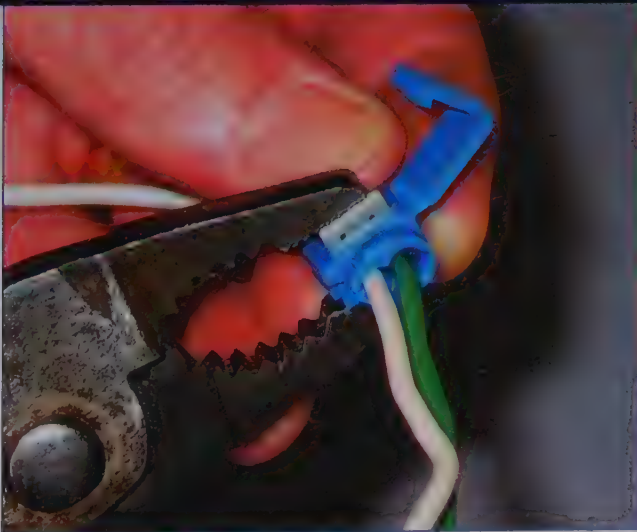


. . . push the "run" wire (the wire that is to power the component you're installing) into the inner channel until it stops (make sure it goes past the blade, all the way to the end) . . .

Quick-splice connectors

The main advantage of quick-splice connectors is that you don't have to strip off any insulation or cut any wires to make a connection. These connectors are commonly used to "tap into" a wire in the vehicle's wiring harness without actually cutting the wire itself. If you need to later remove the component, you can remove the snap-splice, then tape over the area where the insulation was cut. The vehicle's wiring harness will be (almost) back to the way it was.

To make a snap-splice connection, simply open the clamshell-style connector, place the wire you're going to tap into and the new wire you're installing into their respective channels, squeeze the guillotine-like blade down into its slot (which slices through the insulation of both wires and contacts the metal conductors of both wires), fold the clamp over until it snaps and you're done.



. . . squeeze the blade into the slot and snap the clamp into place



Head units

To give your audio system a decent start, you need a good head unit to provide the signal that an amp will beef up, and that the speakers will replay. Being the first link in the audio system's chain-of-command, makes it important to select the right head unit. You'd be well advised to spend some time selecting the right head unit for the job.

Some factory head units require removal keys. Check the Haynes manual for your vehicle for the correct removal procedure





If the opening in the dash is larger than your new head unit, a vehicle-specific installation kit will be necessary to take up the extra space

Head units are commonly referred to as the radio or receiver and are usually mounted somewhere in the dash.

Today's head units are more than just volume, balance and tuning controls. Every year the manufacturers offer more exciting and high-tech features that can sometimes get confusing at the time of purchase. Take time to decide what features best suit your needs.



To avoid cutting off the factory plugs from your wiring harness, use an adapter wiring harness when installing an aftermarket radio. This enables your aftermarket radio to directly plug into your vehicle's factory harness



A few things to think about:

CD Changer Controls: Does the head unit have the ability to control an external CD changer? Most aftermarket head units are designed only to work with changers of the same brand, although adapters are available which enable a head unit with changer controls to function with a different brand changer.

Satellite Radio Controls: This type of head unit can accommodate the separate satellite tuner module connections and has built-in controls for tuning the stations.

Preamp Outputs: Output jacks located on the back of the unit that supply signal to a separate amplifier via RCA patch cords.

Changer Direct Digital: A connection from the head unit to the changer that can be a special multi-pin cable, fiber optics, or digital coax cable.

In-dash Hard Drives: A type of head unit that has the ability to store hours of digital music files that have been uploaded from your computer.

CD-R, CD-RW/Digital Playback Capability: Are you going to play CD's you've ripped with MP3s? If fitting hours of music onto one disc is your thing, you'll need to purchase a head unit compatible with CD-R or CD-RW discs.

ID3 Tags: Is the head unit going to play MP3 tracks? If so, consider purchasing a unit that displays the identity of each track.

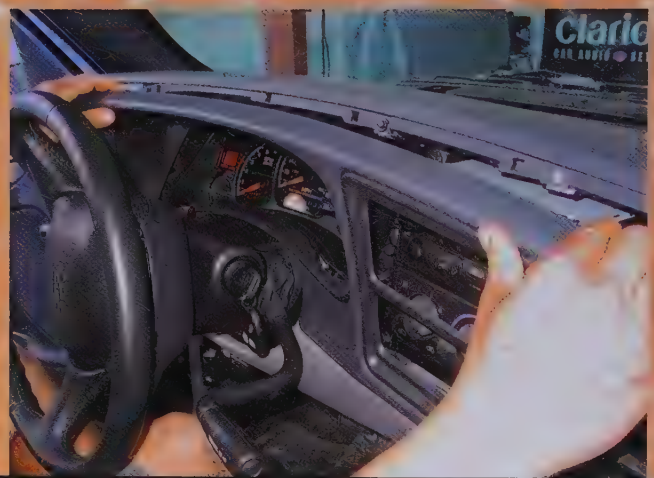
Displays: Audio head units are available with a variety of different types of displays; multi-color backlighting, dot matrix text, touch screen programming, multi-color animated LCDs, and even screensavers you can customize with your own photos or text messages.

Theft Deterrence: While no theft system for your head unit is completely foolproof, several manufacturers have developed different strategies for the battle against car stereo thieves. A common type of theft-prevention design is the detachable face. This feature enables the owner to remove the control panel from the unit and carry it in a pocket or purse. Another type of security would be the hidden face design. The control panel and display go black when the unit is turned off; when the stereo is turned off the thief is fooled into thinking the head unit is just a black panel on the dash board. Other manufacturers have designed a similar idea, having the control panel retract when the power is turned off, leaving a black panel concealing any controls or display.

Remote control: A wireless remote control that usually adjusts volume and preset scans. A handy feature to help keep your eyes on the road while driving.



Installation



01

Refer to the Haynes manual for your vehicle on how to remove the factory radio. With this vehicle we had to first remove the dashboard trim panel . . .



Blaupunkt's Casablanca CD51 car stereo CD receiver



02 ... then by pushing the tabs at the sides of the radio, the unit was slid forward from its mounting bracket



03 With the player hanging out, it was easy to disconnect the harness and antenna



Warning: If you're working on an airbag-equipped vehicle, see the Warning on page 9 before starting this procedure.



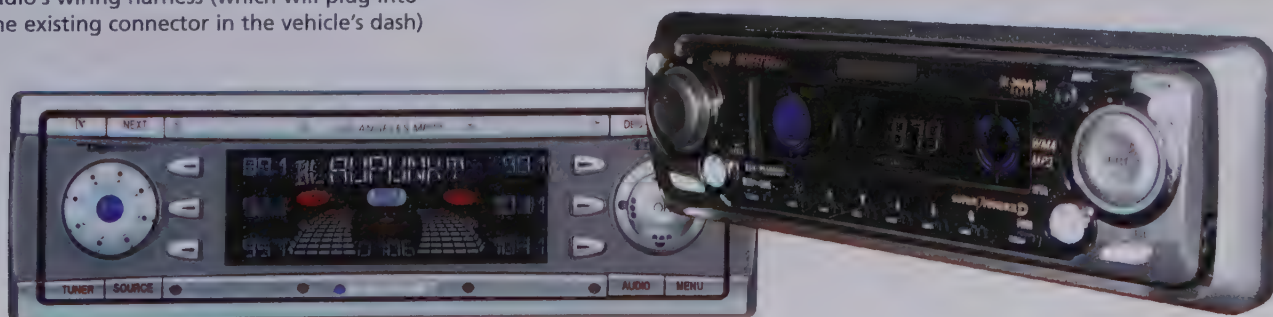
04 Follow the manufacturer's instructions for connecting the wiring to the new radio. In this case we needed to solder an OEM connector to the radio's wiring harness (which will plug into the existing connector in the vehicle's dash)



05 We covered each soldered joint with shrink tubing for insulation



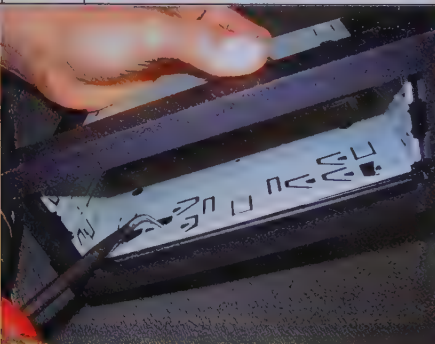
06 Since our new head unit is not a DIN-and-1/2-sized unit like the original, we had to fit an adapter bezel to take up the extra space



Blaupunkt's Los Angeles MP72 MP3 CD receiver

We placed the radio mounting sleeve into the adapter bezel, then bent the sleeve's mounting tangs to keep it in place. Be sure to bend enough tangs so the sleeve is secure

07



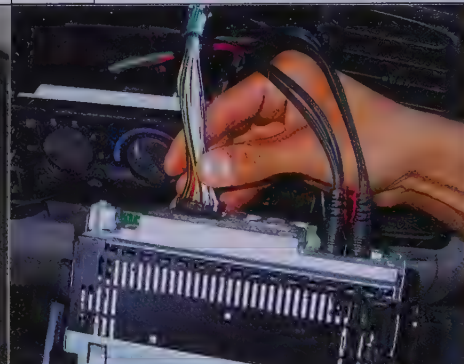
Carefully slide the radio into the mounting sleeve until it snaps into place

08



The antenna, amplifier signal leads and radio harness are connected to the head unit

09



10

Now its just a matter of sliding home the radio and adapter bezel

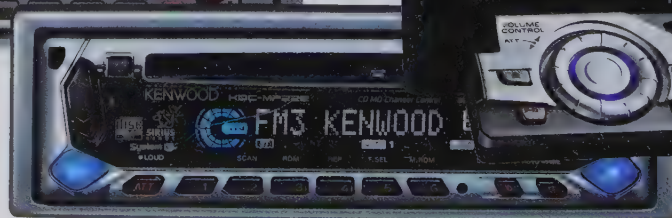


11

Once it had clicked in, we added the dashboard trim panel to finish it off. Nice job!



Blaupunkt's San Jose MP41 MP3, WMA CD receiver



Kenwood's KDC-MP222





An installation kit

This factory Double DIN head unit is replaced

... with the help of an installation kit



... with an aftermarket DIN head unit.

Not long ago, the car stereo industry accepted the DIN (7 1/8" x 2") as the standard head unit

chassis size. This enabled aftermarket companies to manufacture installation kits for many different makes of cars. Major dash surgery was no longer necessary when installing an aftermarket head unit.

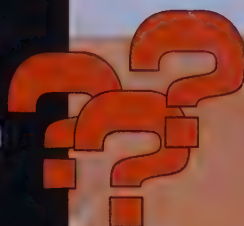
Today it seems the vehicle manufacturers have been slow adopting this standard size. Other terms for sizes have been adopted to accommodate the varying dimensions.

How will it fit in my dash?

DIN: This term refers to the most common size of head unit. The rectangular unit fits in a similar size slot in the dash.

Double DIN: This chassis size is about the same as two DIN size units.

ISO-DIN: A mounted head unit that has a dash trim panel that fits over the front (Toyota, Mitsubishi, Nissan).



Head Units

If my current factory head unit is Double DIN, can I replace it with a DIN size aftermarket head unit?

Yes, depending on the availability of an aftermarket installation kit for your particular vehicle model.

What is an adapter harness?

This is a wiring harness that allows you to disconnect your stock radio and connect an aftermarket head unit without cutting your factory wiring.

What is the AUX input jack used for on the front of my head unit?

This is for connecting an additional source to the head unit, maybe a portable CD or MP3 player.

My head unit can identify ID-3 tags. What is an ID-3 tag?

An ID-3 tag is the displayed information identifying each audio track on a text-encoded MP3 disc.

What are the RCA outputs used for on the back of my head unit?

These are usually low-level signal outputs for connecting an external amplifier.



Kenwood's Excelon KDC-X969 CD/MP3/WMA Receiver with Changer Control



03

SPEAKERS



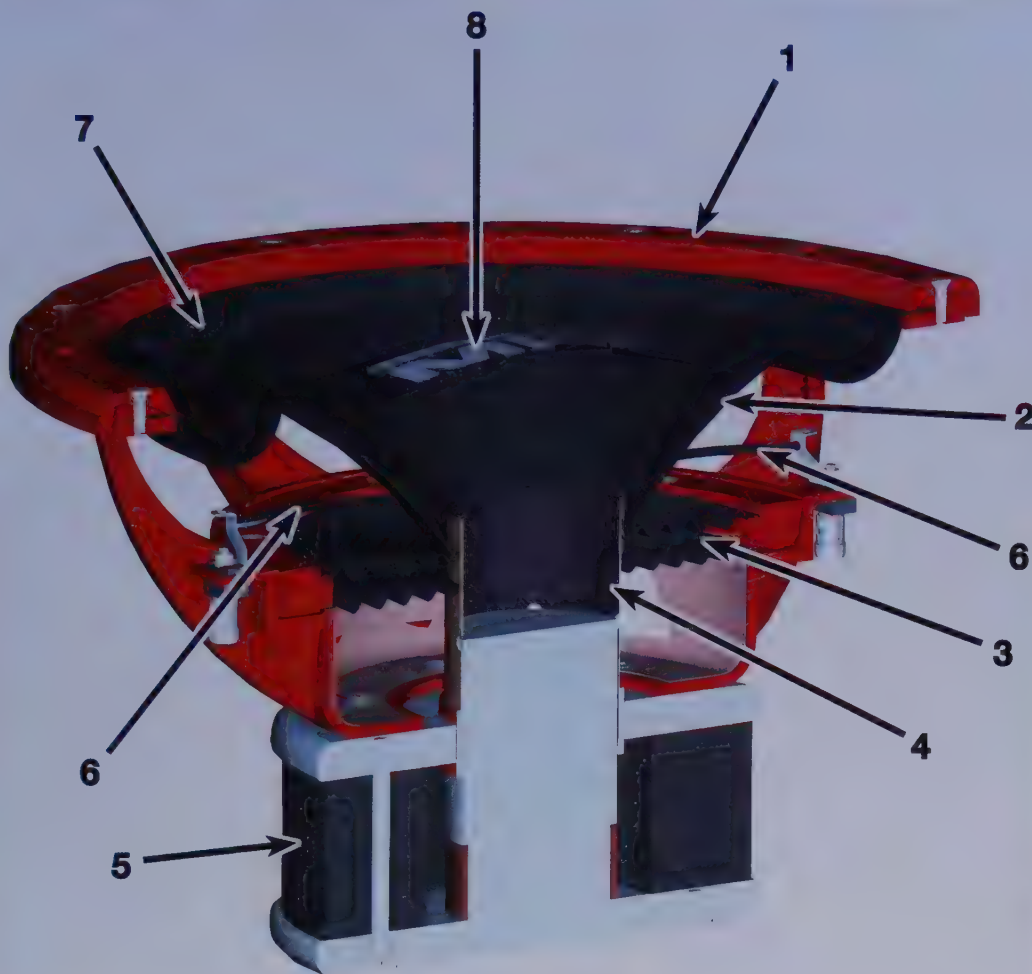
Speakers

The most important components in your sound system are the speakers. Sure, the source unit from where the speakers receive their signal is also very important, but it's up to the speakers to actually convert that signal into the sound that you hear. (Keep in mind, though, if your head unit is putting out a poor signal, a good speaker will do its best to reproduce that bad signal, with the results you might expect!)

The speaker can represent the easiest way to upgrade an existing system or the final step in an expensive custom sound system.

That's why it's important to understand what a speaker does and how it works. Let's take a look at the components that make up a typical speaker.





1 Frame

The frame provides a solid support (most are stamped steel) for the components and holds them in alignment.

2 Diaphragm (or cone)

The diaphragm is usually made of treated paper or polypropylene and is connected to the voice coil. The diaphragm vibrates to send the movement of the voice coil out into the air as sound waves.

3 Spider

Made of special treated cloth, the flexible round ribbed spider provides support for the diaphragm by filling the space between it and the frame.

4 Voice coil

The voice coil is made up of wire wound around a tube called a former that moves in and out within the assembly between the core and the magnet, kind of like a piston.

5 Magnet

The magnet provides a magnetic field for the voice coil to react against.

6 Tensile leads

These thin, flexible leads carry the amplifier's electrical signal from the speaker terminals to the voice coil.

7 Surround

The diaphragm's outer circumference attaches to the frame by the flexible surround. The surround controls the diaphragm's movement so it maintains its shape as it moves in and out. These are usually constructed from foam or rubber.

8 Dust cap

As its name implies, the dust cap is a dome located in the center of the diaphragm that keeps dust out of the voice coil. It also helps to project sound.



One set of each of these components makes up a speaker "driver." Drivers that handle the highest frequencies are *tweeters* and are generally quite small. Drivers that handle the lower frequencies are called *woofers* and are much bigger. Drivers that handle the frequencies in between are, appropriately named, *mid-range drivers*. Drivers that handle the ultra-low frequencies are called *subwoofers* and can be quite large and ridiculously heavy (see the next chapter for more information on subwoofers).

A speaker with only one driver is known as a *one-way* speaker. A speaker with two drivers, for example a mid-range and a tweeter, is called a *two-way* or *coaxial* speaker. If it combines a woofer, mid-range and tweeter, it's a *three-way* or *triaxial* speaker.

The reason for having these different size drivers is simple; to project as accurately as possible the sound that the signal from the head unit is trying to reproduce. A large driver would fail miserably trying to create a high-frequency sound, simply because it can't vibrate fast enough. A tweeter couldn't possibly produce a bass note because of its short travel and inability to move the required amount of air. But all combined, an accurate reproduction of the sound being transmitted or played on the head unit can be achieved. In order for this to happen, however, the frequencies have to be divided up and sent to the proper drivers. This is done by a special filter called a *crossover*, which will be explained later.



Shopping for speakers



So you want higher-fidelity sound from your system and you've decided to change out your speakers. Now what?

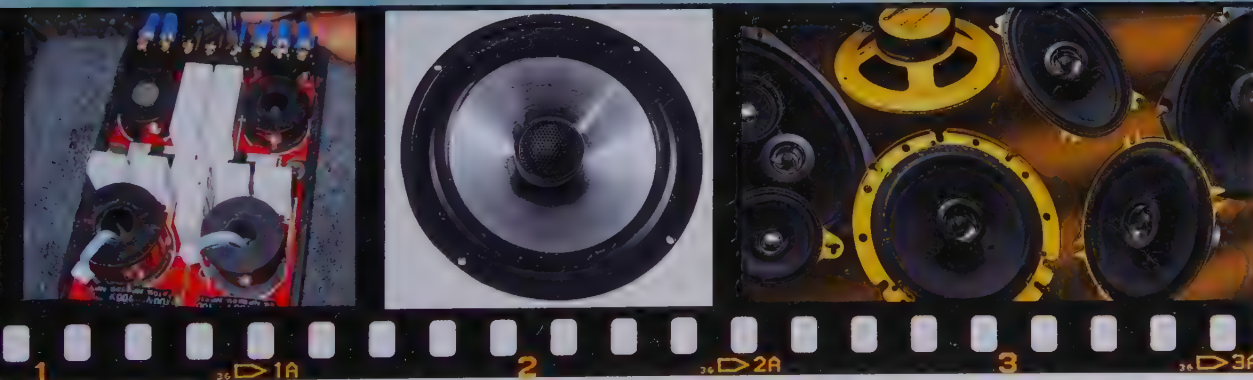
First you have to decide if you're just going to swap your factory speakers for higher-quality units that will drop right into place without any modifications, or go with component speakers that will require some fabrication to accommodate them.

Let's say you want to buy speakers that will fit perfectly in the stock locations. Here are a few things you'll want to toss around in your mind:

- **Size** - Diameter, depth and, on coaxial, triaxial and quadaxial speakers, tweeter protrusion. You have to make sure that the locations in which the replacement speakers will be mounted will accept the speakers. Many retailers will have specifications for your exact vehicle, along with a list of speakers you can choose from.
- **Continuous power rating** - This spec, measured in watts RMS, is the amount of power the speaker needs to operate at a sensible level. The lower the bottom number in the range, the less power required to drive the speaker. If the bottom number is less than eight, you'll have no trouble hooking up the speaker to a low-powered head unit. If the number is more than eight, you'd be better off using the speaker with a higher power head unit or an amplifier.

- **Efficiency (or sensitivity)** - This rating indicates the speaker's ability to put out sound with a certain power input. A speaker with a higher efficiency or sensitivity rating will be louder than a speaker with a lower rating given the same input power. Pick speakers with a high efficiency rating if you have a relatively low-powered stock head unit. If you're running an external amp or have a high-powered head unit, low efficiency speakers are OK (they just require more power to drive them).
- **Peak power handling capability** - This rating indicates the speaker's "redline," measured in watts. It's the amount of power the speaker can handle in short bursts, not sustained levels.
- **Price** - As with most anything, you get what you pay for when you buy speakers. Generally the most expensive speakers you can afford will give you the best performance.

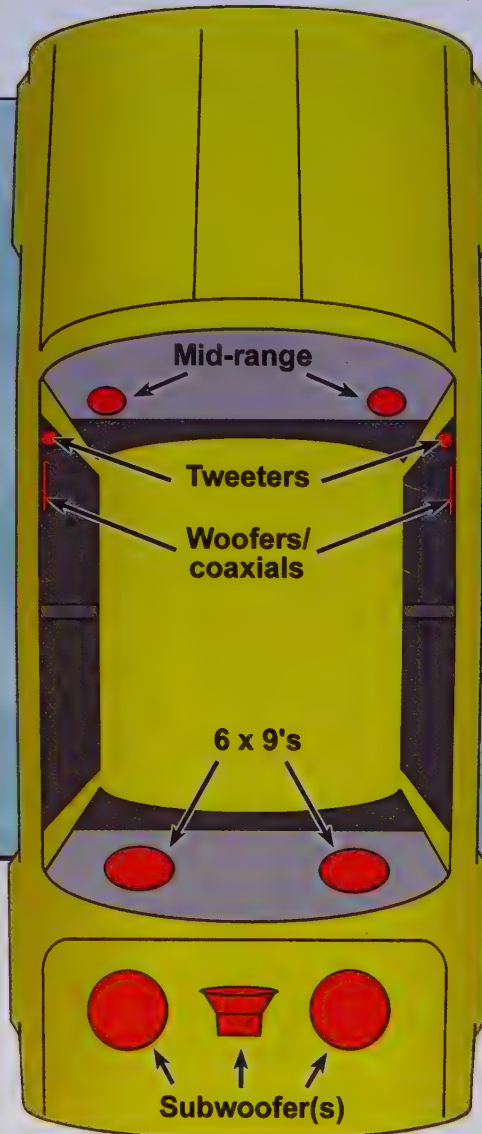
You may also want to consider installing coaxial, triaxial or quadaxial speakers (also known as two-way, three-way and four-way speakers). This will give you a broader range of sound coming from the speaker mounting location. Some experts recommend going with coaxials; they say the higher ranges get a little harsh with the triaxials and quadaxials. The only way to really tell if a speaker suits your tastes, though, is to "audition" it for yourself. Most good stereo shops are equipped to let you do this, and even though it won't sound exactly the same as it would in your vehicle, it'll give you a good idea of its sound characteristics.



How a speaker works

The system amplifier (whether it be a separate component or built into the head unit) sends alternating negative and positive signals to the voice coil. The voice coil moves back and forth like a piston within the magnet in response to these positive and negative signals (it essentially becomes an electromagnet traveling inside the permanent magnet). The movement (vibration) of the coil turns into sound by transmitting the motion to the speaker diaphragm, which produces the air movement, causing sound waves to be projected into the air.

The faster the air moves, the higher the frequency produced. A voice coil on a lower frequency speaker such as a 50Hz woofer, for example, moves back and forth 50 times per second, while on a higher frequency speaker such as a 20kHz tweeter, the coil will move up to 20,000 times a second.



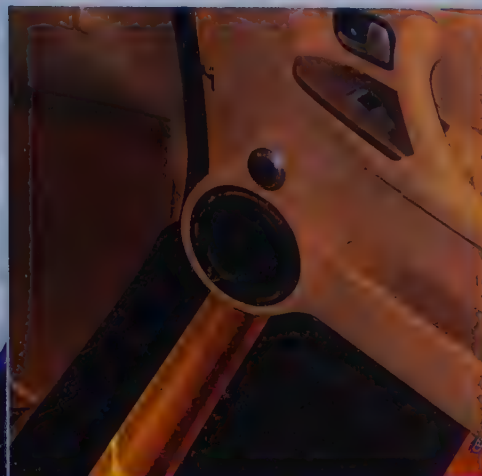
Speaker placement

How the speakers are arranged plays an important role in the "soundstage," or where the music seems to be coming from. When you listen to a live performance the musicians are in front of you, spread out across the stage. It's easier to determine the location from where the higher frequencies are emanating, a little less so for the mid-range tones (because they are usually the most prevalent), and actually difficult to tell from where the bass is originating. Try walking around a concert hall sometime and compare the differences between the tones; no matter where you go, the bass will sound pretty much the same, but the mids and highs will be noticeably different depending on where you are.

Therefore, it makes sense to use this analogy when deciding where to install aftermarket speakers. This is easier said than done, though, because you are somewhat limited in your choices of placement since you're working in a very confined space instead of a stage!

- If you're simply replacing your factory speakers with higher quality units, you obviously can't do a whole lot to alter the soundstage, but you definitely will notice an improvement in sound quality. Replacing a stock mid-range speaker with a coaxial or triaxial speaker that will drop





right into the factory mounting hole is an excellent option, and easy to do. Some of these units are equipped with tweeters that can be rotated and "aimed" to compensate for a less-than-ideal mounting location.

- If you're installing component speakers (separate tweeters, mid-range and woofers/subwoofer), you'll want to mount the tweeters up front and fairly high, aimed toward the center of the front seats. Ideally the mid-range speakers would be mounted in the dash, pointing at the front seat occupants. Specially formed kick panels designed to aim mid-range speakers towards the occupants are also available. Woofers can be mounted down low, since it's harder to detect the source of bass anyway. Subwoofers, pumping out ultra-low frequencies, can be mounted just about anywhere there's room to fit them.

It's worth mentioning that no matter how well done any given sound system is, it won't necessarily please everyone. Just as beauty is in the eye of the beholder, sound quality (and the enjoyment it brings) is in the ear of the listener.



Kick panel speaker enclosures

Kick panels are a great place to mount speakers, but to do it properly takes quite a bit of fabrication. You don't want to just mount a speaker flush in a kick panel (even if there is enough room for it), because it would point right at the occupants' feet. Rather than cannibalize and modify your existing kick panels, you can purchase custom replacement kick panels that'll fit right into place, match your interior and fire the speakers right up at you. This will give you a decent soundstage with a minimum of effort.

Speaker polarity

When installing speakers, whether they be drop-in replacements for factory units or part of a full-on custom installation, you'll have to determine their polarity before connecting the wires to them. This is important because the signals that the speakers receive cause the voice coils and diaphragms to move inward and outward, thus producing sound. BUT, if one speaker is wired one way and the other speaker is wired just the opposite, parts of the sound spectrum could be canceled out, or at least be affected in a bad way. That's why you need to figure out the positive and negative terminal of each speaker if it isn't clearly marked (the positive terminal will either be labeled with a + or a spot of colored paint).

Attach a set of jumper leads to the terminals of a typical 1.5-volt battery (the size of the battery doesn't matter - it could be a D-cell or a AA). You can solder or tape the leads in place. Now touch the leads to the terminals of the speaker and watch what happens to the diaphragm (cone) of the speaker. If it moves outward, the jumper lead from the positive battery terminal is touching the positive terminal of the speaker. If the cone is pulled inward, the jumper lead from the positive battery terminal is touching the negative terminal of the speaker. Mark the speaker terminals accordingly, then make sure the positive signal wire is attached to the positive terminal at each speaker.



Crossovers

Crossovers separate different frequency bands and redirect them to the proper drivers. Without some type of crossover, these ranges of sound can't be separated, resulting in an audio system that sounds "flat" and/or distorted. So, they're incorporated into the system to send the high frequencies to the tweeters, mid-range frequencies to the mid-range speakers, low frequencies to the woofers, and ultra-low frequencies to the subwoofer(s), if used. Some are adjustable and can be set to separate these ranges at certain frequencies, thereby eliminating the frequencies that the speaker can't use (or that would cause it to operate inefficiently). Others aren't adjustable, and some are built right into a component (like a triaxial speaker).

There are two types of crossovers: active and passive. Active crossovers are placed into the signal chain before the amplifier, and require a separate DC voltage input to operate. Some amplifiers have built-in active crossovers.

Passive crossovers are placed into the signal chain between the amplifier and the speakers. They don't require DC voltage to operate. And, since they are connected just before the speakers, one amplifier can drive a number of speakers correctly.



Speaker installation

Component speakers and crossovers



Other items you may need for speaker installation

In addition to the speakers themselves, here are some items that you should pick up before you go back home to do the install:

- **Wire** - If you are doing a custom install and mounting speakers in places other than the stock locations, make sure you have plenty of speaker wire. Once your interior is all torn apart, you don't want to be caught short of wire and have to piece it back together to drive back to the stereo shop!

- **Connectors and solder** - These are the staples of the installation. Figure out what kind of connectors you need and how many, then buy more than that. When soldering splices or connectors, use only resin core solder.

- **Shrink tubing** - Along with the connectors and solder, get some shrink tubing to cover your solder joints. It makes for a much cleaner-looking installation than electrician's tape, not to mention a more secure and longer-lasting one.

- **Jumper harnesses** - Check on the availability of special jumper harnesses that will connect your new speakers directly to your vehicle's wiring harness. These will make an easy job even quicker and easier and will allow you to retain your original electrical connectors just in case you wish to sell the car someday and reinstall the old speakers.



01

We chose to install a set of Focal Utopia component speakers with passive crossovers for the front doors

The door panel was pretty straightforward to remove, just be sure you've got all the screws out before you try to yank the panel off. Most door panels are also secured by push-in plastic fasteners around the perimeter of the panel (check your Haynes Automotive Repair Manual if necessary)

02

The factory tweeter mounting panel is removed from the back side of the door panel

03





04 Once the tweeter mounting panel is removed, we use it as a template for a new mount



05 Using a jig-saw we cut the new mount . . .



06 . . . then drilled out a hole big enough for the tweeter



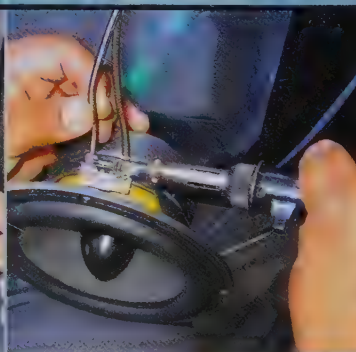
07 After applying the matching paint and following the manufacturer's instructions for assembling the tweeter with its mounting clip, we then used a little hot glue and fit the tweeter to its location on the door panel



08 The factory speaker was taken off the door



New wire for the tweeter and speaker was fed through the inside of the door and later fed through the rubber boot and door pillar



10 Next, the new wire was soldered to the speaker



11 The speaker was then carefully mounted to the door



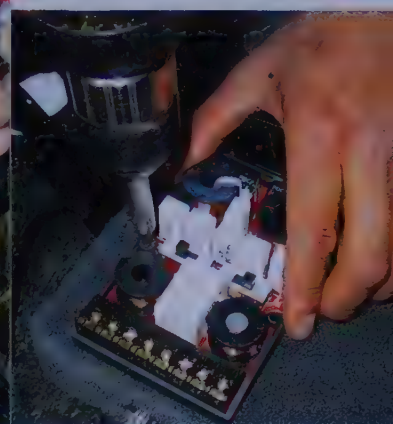
12 Back at the door pillar, we fed the tweeter and speaker wire through the harness rubber boot ...



13 ... then carefully reinstalled the boot to prevent any water leaks



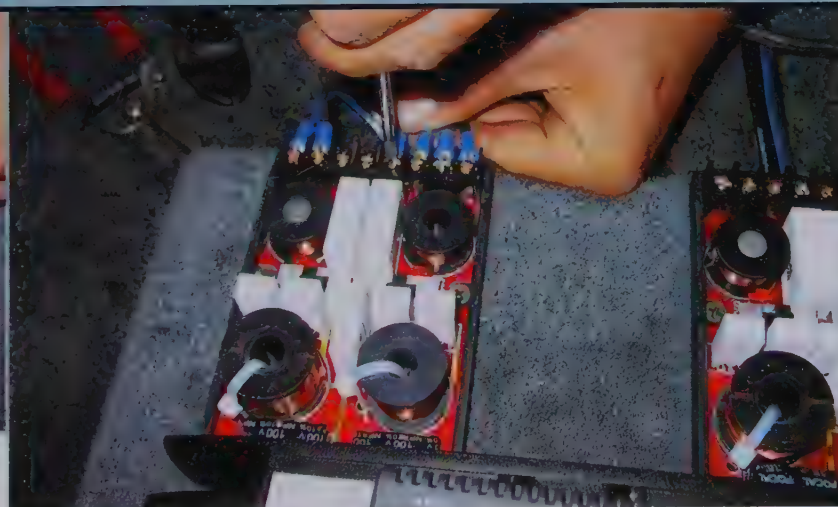
14 After the door panel was installed, the tweeter wire needed extending to the crossover, so we soldered another length of wire onto the short lead coming from the tweeter. The wire was then fed under the carpet to where the crossovers were to be mounted



15 The crossovers were mounted conveniently next to the amplifier, under a rear seat

16 We added terminals to the wires ...

17 ... then following the manufacturer's instructions, connected them to the crossovers



Direct replacement speakers and crossovers

01

A set of Focal Polyglass coaxial speakers and passive crossovers are being installed in the rear doors



02

We moved to the rear door and started by removing the door panel



03

The factory speaker was removed ...



04

... and the crossover is connected to the speaker

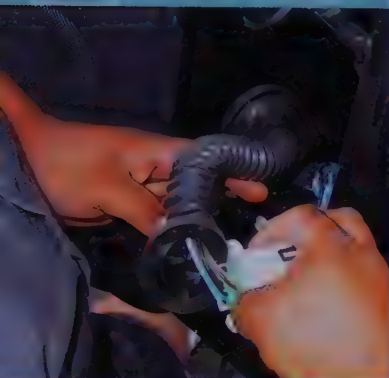


05

Carefully the speaker is then mounted

06

By removing the door's harness boot . . .



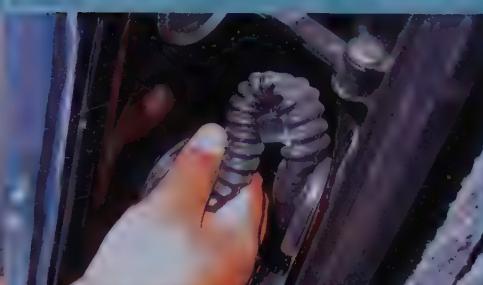
07

. . . the speaker wire is fed through the boot . . .



08

. . . then the boot is carefully reinstalled to prevent any water leaks



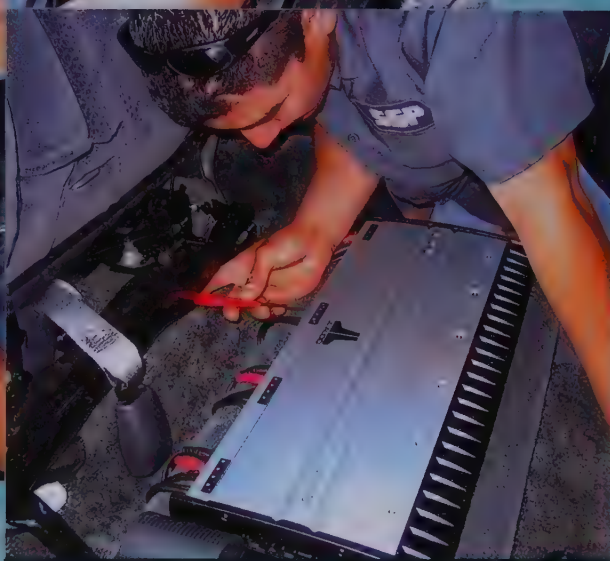
09

The speaker wire is then soldered to the crossover's lead wires



10

We securely mounted the crossover to the inner door panel using duct tape



11

With the door panel reinstalled, the wiring from the door was fed under the carpet, then, following the manufacturer's instructions, it was connected to the amplifier



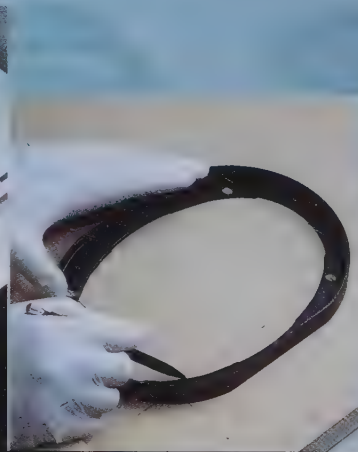
Package tray speaker installation

The following procedure can be used to replace existing package tray speakers (without the fabrication of a new tray, like we're about to show here) or the addition of rear speakers in the package tray where none existed previously.

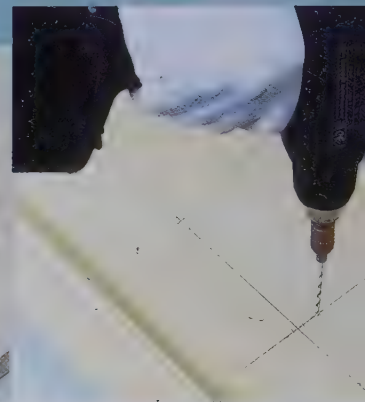
There are a couple of things that you should be aware of when using a medium density fiberboard (MDF) shelf, and the main one is the weight. They weigh a ton when they've got speakers mounted, so make sure you've got yours well secured before you take to the street.



01 We marked the speaker position on the underside of the shelf carefully to get both speakers in the same place



02 Using the speaker grille collar we drew in the position of the mounting screws and the outline of the opening . . .



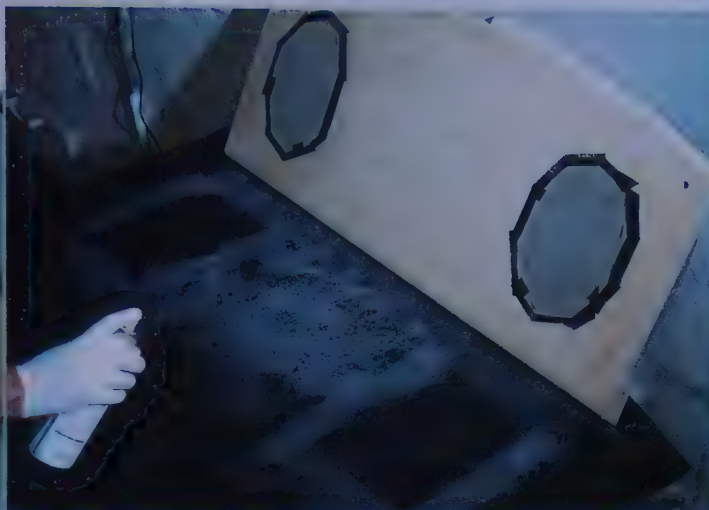
03 . . . and then drilled a few pilot holes in a row for the jigsaw blade. Also, drill pilot holes for the speaker screws so they'll twist in cleanly. After cutting the speaker holes we sprayed the underneath of the shelf black



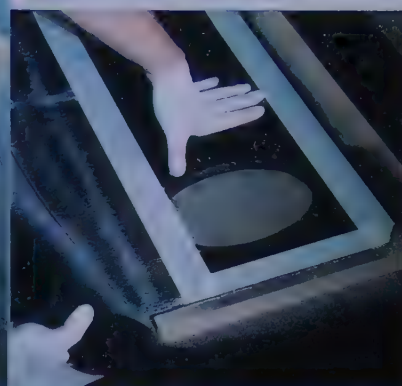
Warning: MDF dust is hazardous to your health. Wear a mask when you're cutting, drilling or sanding it



04 With the shelf facing up, a couple of pieces of speaker cloth were pulled tight and stapled across the speaker holes. This was done to stop the new carpet trim from sagging into the speaker in the future



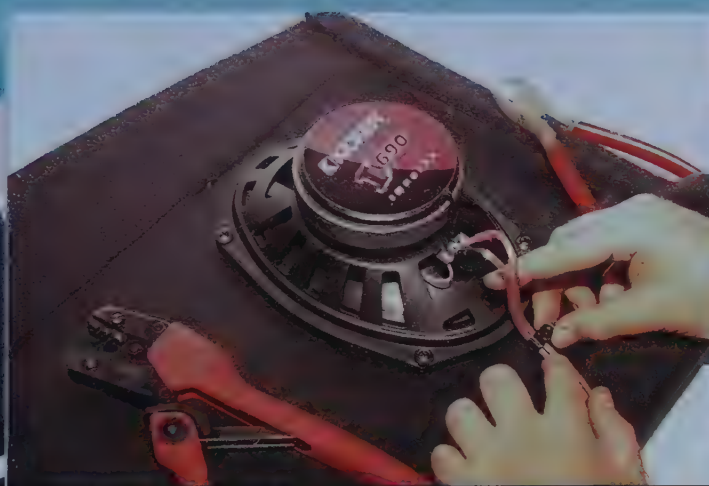
05 We stuck a little insulating tape over the staples to smooth them out before we started gluing the carpet and shelf together. We sized the carpet to make sure there was an adequate overlap under the shelf so that we could cut it off neatly. Then we stood the shelf on its edge on the upside-down carpet, ready for gluing. The glue was sprayed onto the shelf and the carpet, taking care to avoid the grille cloth that will cover the speakers. Once the glue had gotten tacky, the shelf was dropped forward onto the carpet and then flipped over to smooth out any wrinkles



06 After masking up the shelf to give us some straight edges to work with, we glued the overlapping carpet and the shelf, then finished off the trimming



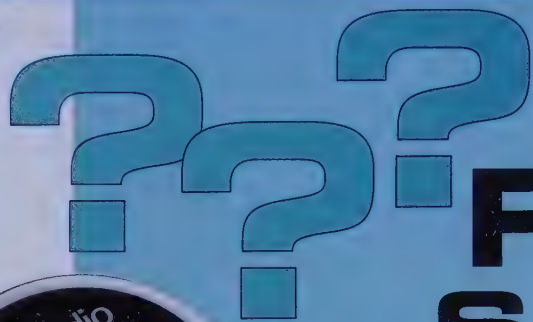
07 The 6x9 speakers were screwed into the shelf using the pilot holes we'd drilled earlier, and then the wiring was added to them. Be careful you don't let the screwdriver slip off the screw and go through the cone, though!



08 For the wiring hook-up we used push-on terminals for these speakers . . .



09 . . . and the cabling was tidied up using P clips to hold it at the front edge of the shelf. All that's left now is to mount the shelf in the vehicle and connect the wiring (either to the factory wiring harness, if present, or to the head unit, crossover or amp, whatever the case may be)



FAQs Speakers

Courtesy of Polk Audio



Can my car stereo really hurt my ears?

Sure. Prolonged exposure to sound pressure levels of about 85dB will cause permanent hearing damage. Professional audio competitions specify the use of hearing protection devices for their contests, especially at higher volume levels. You can test the dB level of your car stereo with a Sound Pressure Level Meter (available at Radio Shack). If you're disoriented and your hearing is sort of muffled after you've been listening to your car stereo, or you hear ringing in your ears, then turn it down! If you have to shout at the person in the passenger seat, and you're not angry with them, then it's a good bet that your stereo is too loud. For the sake of your hearing, turn it down.

Why did my speaker blow?

Most speakers fail due to excess distortion caused by an amplifier being pushed beyond its power capabilities. When an amplifier is driven beyond its safe operating range, it distorts or 'clips' the audio signal, and sends this clipped signal to the speaker. This produces both mechanical and thermal stresses on the voice coil. In plain English, the voice coil gets banged around and overheated and breaks. Although it doesn't make "common sense," you're less likely to blow a speaker by using too much power than not enough. If you like to play it loud, get a bigger amplifier.

The other common cause of speaker failure is trying to get too much high volume bass out of a small speaker. Eventually the speaker reaches its excursion limit, its limit of physical travel. The voice coil bangs around, gets bent and the speaker breaks. This is a common problem with 5-1/4" and smaller full-range and coaxial speakers. There's an easy way to prevent this type of failure – limit the lowest bass frequencies to the driver with an in-line capacitor or "bass blocker." You'll only be filtering out the bass frequencies the speaker can't reproduce so you won't be missing anything, especially if you're using a subwoofer. Any car stereo installer can help you choose the right value for your speakers.

How much power would work well with my speakers?

If you read the previous FAQ, you already know that you're better off with too much power than not enough. But like everything else in life, too much of even a good thing can be bad; speakers can be overpowered.

All speakers come with power handling specs; you should use these to determine how much power you will need. There are two kinds of power handling specs: continuous (RMS) power handling, and peak or max power handling. Continuous describes the power handling with a constant volume test tone. The peak power handling describes how much power the speaker can handle on a very time-limited basis, usually on the order of milliseconds. As music is transient in nature (the volume goes up and down a lot) the peak or max rating is the most useful for determining amp size for a given pair of speakers. For



example, for a speaker rated at 100 watts peak, get a 100 watts/channel amplifier to safely get the greatest amount of volume from that speaker. If all you know is the continuous power of an amp, use the 3/4 rule, divide the continuous rating by 0.75 to calculate the maximum amplifier size. For example, a speaker with a 50 watt continuous rating can be safely used with an amplifier of 70 watts/channel ($50 \div 0.75 = 66.7$, round up to 70 watts).

How do I tell if my speakers are in or out of phase?

If your speakers are out of phase, imaging will be vague and bass output will be reduced. To ensure that your speakers are hooked up in phase, check to make sure that the positive and negative leads are connected the same way to both your speakers and your receiver or amp. Make sure red is connected to red, black to black, etc. Check for correct phasing using a 1.5-volt battery. Disconnect the speaker wire from the amp. Touch the wire you think is negative to the negative battery terminal. Touch the positive wire to the positive battery terminal. If your speakers are wired in phase, the speaker cone will move "out" and stay there. If they are out of phase, the driver cone will move "in" and stay there. (This won't help you for tweeters, only midrange and woofers. So when you're wiring your tweeters, be careful. Do it right the first time.)

Phasing is never absolute in car audio situations, since speakers are rarely facing the same directions. Phasing differences mostly affect bass. Is your system totally lacking bass? Try changing the phase on your sub system. 90% of the time, that's the key to more bass!

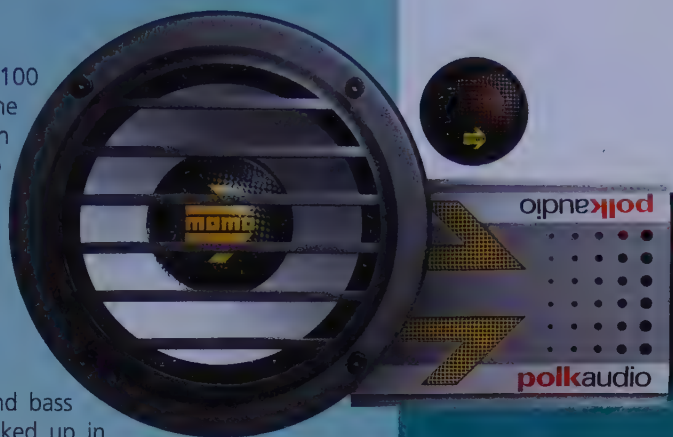
How do I use my faders and balance settings to make my system sound better?

Proper setting of your front-to-rear fader and left/right balance controls is important for optimum staging and imaging in your system. Too much sound in the rear of the car (sometimes called "rear fill") will often eliminate staging altogether, forcing sound away from the front of the car, while too little rear fill will sound dull. Too much sound on one side of the car or the other will add an unrealistic element to the imaging. To adjust fade and balance, play a tape or CD you are familiar with and turn the rear speakers on full with the fade control. Listen to the rear speakers, and then slowly turn the fade up in the front speakers just until you can't tell the rear speakers are playing anymore, then ease off a tad. You're probably close to optimum setting when the front staging is such that the rear speakers provide little more than ambiance and space to the sound. Test it by going full on the front speakers (without losing the position you just attained). You'll hear an immediate loss of spaciousness in the sound with the rear speakers faded all the way down. Return to your optimum setting.

Setting the balance is more difficult, so it's always a good idea to leave the balance setting at the "12 o'clock" position. That's as close to equal as you're going to be able to hear with your own ears.

My system "pops" when I turn it off. How do I stop it?

As you power down, transient signals in the processor sometimes find their way into the signal path. The amp transmits them to the speakers, and POP! Add some "turn off delay" to your head unit. Refer to the owners manual that came with your head unit.





Do round speakers sound better than oval speakers?

For all practical purposes, yes. A round cone is more rigid than an oval-shaped cone. At higher sound levels, an oval-shaped cone will distort more. Oval-shaped speakers are made to please the rear deck space considerations of many cars. One advantage of 6x9s, though, is that ovals have more area, and thus move higher air volume and produce more bass.

Where should I put my tweeters for best performance?

The best thing to do is to install the rest of the system and leave the wires for the tweeters long. Grab a buddy (you've got one, right?) and have them hold one tweeter while you hold the other. (This helps you get them separated by the width of the car, something you'll find very hard to do by yourself.) Play some music that you're familiar with and put the tweeter in different locations with your buddy mirroring your placement. Listen for "staging" and "imaging." When you find a spot that works well, mount them there, if you can. If you can't put them where they sound the best, compromise by mounting them on the front door frame (inside, opposite the side view mirror) facing the space between the two front seats.



When I turn my music up, my headlights dim. How come?

Your headlights dim because your system has caused a drop in the available voltage for your car's other, less necessary accessories (headlights, engine, etc.). Voltage drops can be caused by an accessory's large current demand, like an amp struggling to produce a loud bass note. Get your battery and alternator checked. A low battery can overload an alternator, drawing power away from your system. If everything checks out okay, you could be making such large demands on your electrical system that an upgraded alternator may be necessary. A "stiffening" capacitor can also be installed. A stiffening capacitor is like an extra power supply for your electrical system; it keeps a small reserve of 12-volt power. If your car won't start after you play the stereo for a long time with the engine off, try paralleling another battery into your system.

What crossover frequency should I use between my subwoofer and my 6" or 5" mid/bass drivers?

There's no quick and easy answer to this question. It depends on the car and the total design of the system. Generally you don't want a subwoofer to go much higher than 100Hz and 200Hz is the absolute limit. Typically when you set your subwoofer crossover point you will use that as a starting point for your high-pass on your mid/bass drivers. Sometimes you will need to increase the crossover frequency and sometimes you will need to lower it. It is basically all a matter of personal preference and the acoustics of your car. Electronic crossovers make it very easy to try a variety of crossover frequencies to see what works best for you and your car.



Should I use an electronic (active) crossover or a passive crossover?

Electronic crossovers are better and allow greater ease of system tuning, but require the use of more amplifiers and thus expense. Passive crossovers are the way to go if your don't have the money for the additional amplifiers. Be careful with using electronic crossovers for tweeter high-pass filters. Setting a tweeter's crossover point too low may blow the tweeter.

What brand of amplifiers do you recommend?

We recommend that you stick with well-known brands that are available. Most car audio retailers can help with this selection. Beware of "bargain" amps; too much power for too little money generally means that corners have been cut somewhere in quality of construction or service support.

How loud will my speakers play?

Look up the sensitivity rating of the speaker, which is expressed in dB/watt/meter. For example a speaker with an 89dB sensitivity will produce 89dB of sound 1 meter (39") from the speaker with a 1 watt input. For every doubling of power input the SPL (volume) increase by 3dB. So in this case, assuming a 100 watt power handling spec:

Power input (watts)	SPL (dB @ 1 meter)
1 watt	89
2	92
4	95
8	98
16	101
32	104
64	107
128	110

So, the SPL limit of this speaker would be somewhere between 107dB and 110dB at 39 inches.

Do I need to use the biggest amp possible?

That depends on a lot of factors such as how loud you like to listen, how quiet or noisy your car is and how many other speakers and amps are being used in the system. For example, a speaker rated 20 watts minimum and 100 watts maximum (peak) used in a convertible car driven by a 20 year-old hip-hop fan would work best with a 100-watt amp. In a BMW 5 Series driven by a jazz-loving stockbroker, that same speaker would be just as happy with a 40-watt amp.



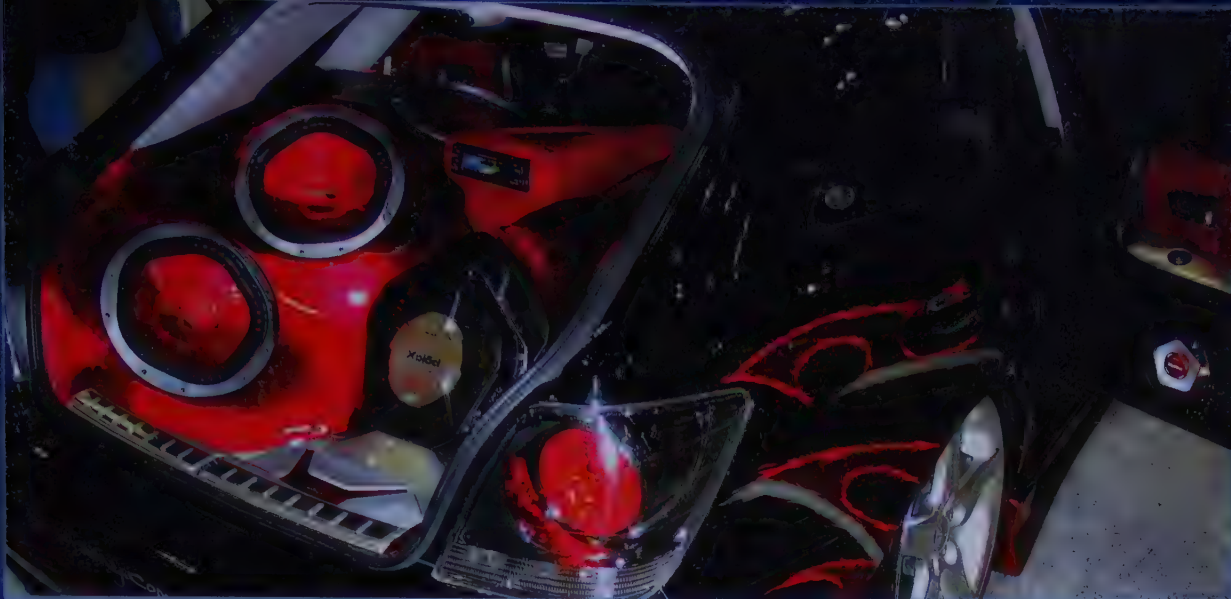
04

Subwoofers



Subwoofers

A great sound system is pleasing to the ear and is the only way to accurately replicate what the artist has intended for the listener to hear. But, as anyone who has attended a high-energy live performance can attest, there is no substitute for being able to *feel* the music. The addition of a subwoofer (or more than one) to bring out the low frequencies will add that extra dimension!



Subwoofer basics

A subwoofer is a driver that handles frequencies below the reach of regular woofers or mids - the frequencies below approximately 125 Hz. Subwoofers also free-up the other speakers in the system to do their jobs the way they were meant to, without being bothered by frequencies they couldn't possibly deliver. This means that the other speakers in the system will project better and be less prone to distortion.

Some subwoofers are self-powered and don't require an amplifier. Non-self-powered subs will require an amp, though. Additionally, a subwoofer needs a crossover to filter out the frequencies that are beyond its range of reasonable operation. Some subs have built-in crossovers, but some require separate crossovers to be properly wired into the system. For more information on crossovers, see the previous chapter.

Subwoofers are usually sold as a stand-alone item, but in just about all applications they will have to be mounted in some type of enclosure. There are many types of enclosures, designed to manipulate the acoustics of the subwoofer(s) depending on the type of vehicle in which it is being installed or the type of music that will be listened to mostly. The physics behind these various designs is not easy to understand and is way beyond the scope of this manual, so as far as installation goes, we'll deal with the most common type - the sealed enclosure.

Sealed enclosures are airtight and produce a tight and accurate bass. These enclosures are relatively easy to design and construct. By purchasing the correct driver and following the manufacturer's instructions for achieving the correct internal volume, you'll be on the way to having a subwoofer box that tends to have a more versatile bass range for all types of music.

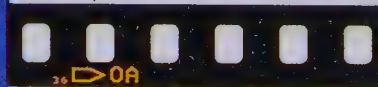
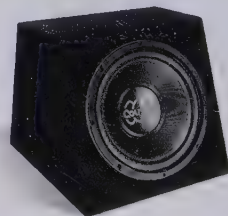
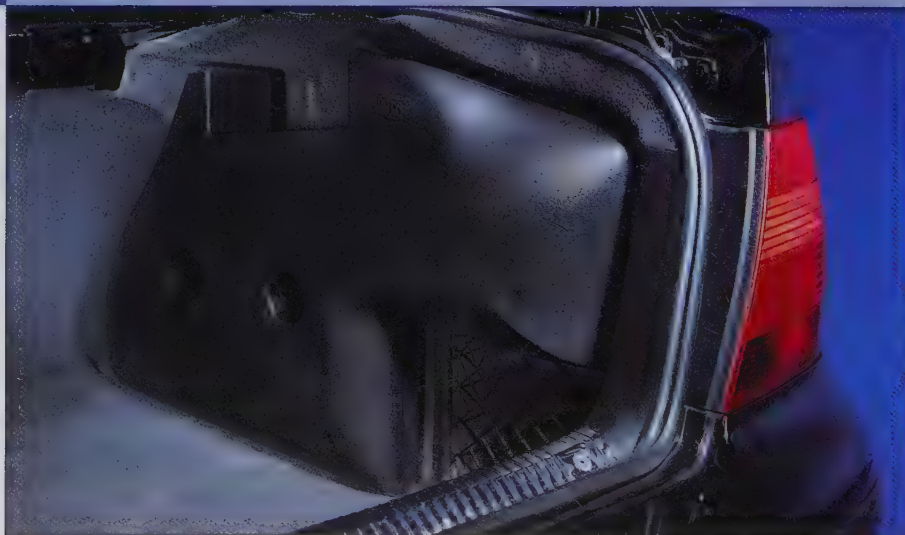




Here are some things to think about to help you plan your addition:

Mounting location - This is probably the single most important factor when it comes to installing a sub; how much room are you willing to sacrifice? Some manufacturers offer modular subwoofer enclosures that are vehicle-specific and designed to fill unneeded voids in the interior, and this is the most hassle-free option. If space is not a problem, you'll then have to determine what kind of sound you're after, which will force you to make another decision - what kind of enclosure will you be using? If you're going with a sealed or ported box, the space it will occupy will be the limiting factor, which will then limit your choice of subwoofer size.

Sound type - What kind of music do you listen to primarily? If you like rap or hip-hop, you'll probably want a "boomier" sound, which will lead you to a subwoofer on the larger side. The cone on a big sub travels farther than the cone on a smaller one, and has a slower response time which gives you a heavier sound but a bit of distortion as well. If you like a "tighter," more accurate punch, a smaller sub will better fit your needs.





How many? - Again, the available space and type of sound you're after are the determining factors. If you're going after the boomy sound, one big subwoofer will probably suffice. If you want the quick response, sound quality and accuracy of a smaller sub, but want lots of it, you may want to think about adding a pair of smaller subs. Of course for some people, too much is never enough and if you're one of those, well, the sky (actually interior space) is the limit!

Amplification - Subwoofers require a lot of power to work properly. If you simply wired up a subwoofer to your head unit like a regular speaker it wouldn't function nearly like it should, and would probably lead you to turn up the volume in an attempt to get it "on the same page" as the rest of the speakers. Doing this would most likely damage your speakers. So, once you've decided on what type of subwoofer setup you want, you'll have to look at the power requirements furnished by the manufacturer of the subs, then go amp shopping too! Keep in mind that powered subwoofers (with a built-in amplifier) are available.

One more thing to think about - you're probably not the first person to install a subwoofer setup in a vehicle like the one you have. Talking to other enthusiasts and visiting some stereo shops will definitely shed some light on this dilemma of what you actually need to get the sound you want.



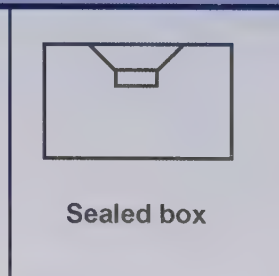
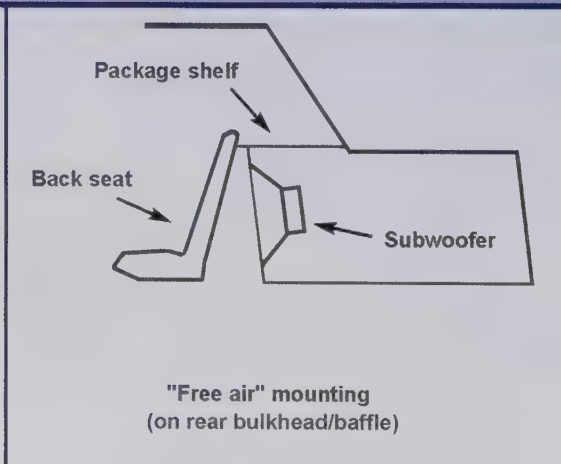
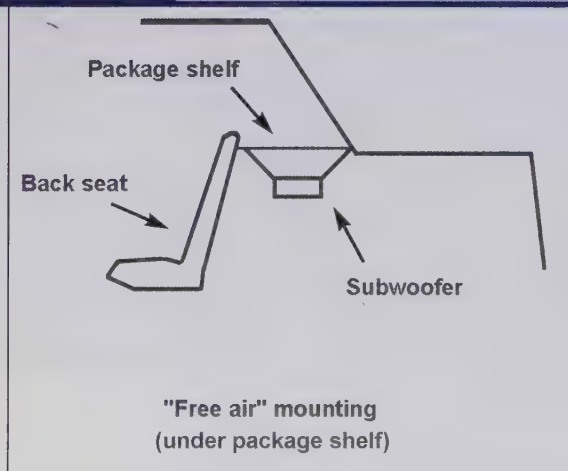
Enclosure types

Subwoofers

There are many different types of enclosures designed to perform in different ways and highlight different parts of the low-end spectrum. No one style of enclosure will be the best design for all music genres, so you really need to come to terms with what sound you're after and what kind of space you have to work with. Here's a rundown of some of the more popular sub boxes out there:

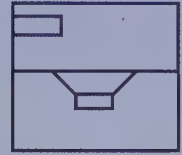
Free air - This is actually not a box that you have to buy or build. In this setup the trunk of your vehicle becomes the enclosure, and the subwoofer(s) mount to the underside of the package shelf or to a board fastened to the structural member behind the rear seat. With this arrangement it is very important to seal and insulate the luggage compartment, otherwise the sub(s) won't be very effective. It also requires more amplification than other enclosures, and not all subwoofers are suitable for free air mounting (the manufacturer or retailer will have that information). Properly done, you'll get good low to medium bass output and you'll still have the use of your trunk.

Acoustic suspension (or sealed box) - This is the most common type of enclosure and the easiest to build. It isn't just a box that you hammer together with nails and bolt the sub into, however. The dimensions must be calculated to match the subwoofer(s) for it to work properly, and it must be thoroughly sealed. Mounting direction isn't all that important, unless the subs are firing at a surface that will cause sound waves to bounce back and cancel them out. Where a sealed box falls short is on the extreme low end (below 30 Hz), so if you're after that boomy, exaggerated bass, this might not be what you want.





Ported box



Single reflex band pass

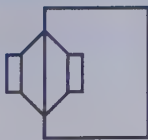
Bass reflex (or ported box) - This type of enclosure is similar to a sealed box, except that it has a hole in it, and a tube mounted in the hole. The port is tuned by increasing or decreasing the diameter and length of the tube. A good ported box is difficult to build (computer programs are available to help you figure out the proper dimensions of the box and port size and length) and has a response time slower than that of a sealed box. They usually have to be bigger than a sealed box for a similar subwoofer, but they also tend to be louder (and "boomier"). When mounting the box it's important not to block the port.

Bass tubes - These are essentially a bass reflex box in the form of a convenient, easily mountable tube. Some are even disguised to look like a nitrous oxide tank! (see photo above).

Single reflex band pass - This is a combination of a sealed box and a ported box; one chamber is completely sealed and the other is ported. This type of box is also difficult to build, but is efficient (low and loud bass) and smaller in size than a sealed or ported box.

Push/pull isobaric (or clamshell box) - This is essentially a sealed box with one subwoofer mounted inside and one subwoofer mounted outside, facing the other. This arrangement won't double your bass output just because your using two subs, but it will give you good bass response in a physically smaller enclosure. When wiring-up the two subs it is essential that one is wired in polarity and the other wired out of polarity (so they both travel in the same direction) - otherwise they would simply destroy each other!

*An important consideration with any type of subwoofer setup is that the sub and box must be securely mounted! Subs are heavy and you would **NOT** want one flying around inside your vehicle in the event of an accident or sudden maneuver.*



Push/pull (clamshell) box





Building a sealed enclosure

First you'll have to locate a good spot for your subwoofer enclosure. Find the largest, out-of-the-way space you can, then take some measurements of that area - length, width and height. Calculate the volume of that area in cubic feet by multiplying the length x width x height, then divide by 1728 (this calculation is for one subwoofer; if you're building the enclosure for two subs, you'll have to double the enclosure's volume). Be sure to allow for the thickness of the material (in the procedure that follows we'll be using 3/4-inch MDF, so you'll have to subtract 1-1/2 inch from each dimension). Now that you have an idea of what the volume of your enclosure will be, you can go shopping for a subwoofer whose enclosure volume requirements will be compatible with your available space.

01 Using 3/4-inch Medium Density Fiberboard (MDF) for the enclosure, mark the enclosure's measurements and carefully cut the boards



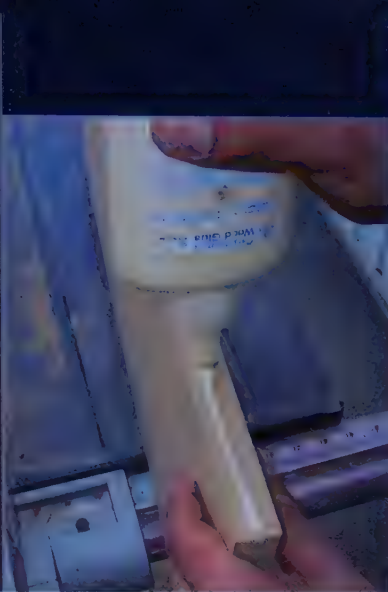
Warning!
Wear a filtering mask before cutting; MDF gives off an extremely fine dust which can be harmful to your health.

05 Join the remaining side panels; be sure to first run a bead of glue along the edges of the adjoining seams

To prevent any air leaks, seal all the seams inside the box with a silicone sealant

06





02

Pre-drill the screw holes to prevent the screws from splitting the panels when assembling the box

03

Run a bead of wood glue along the adjoining seams before assembling them with screws

04

Join the top panel to the rear panel. Carefully align the seam then, using drywall screws, join the rear panel to the bottom panel



Note:

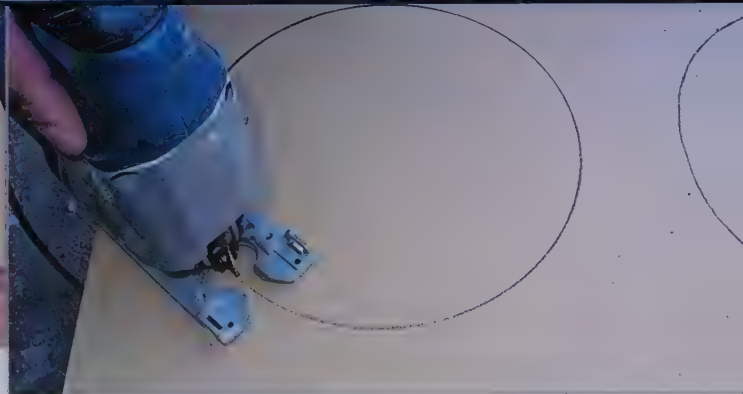
To make the assembly easier, a nail gun can be used to tack the boards together, as shown here, using screws to join them together.

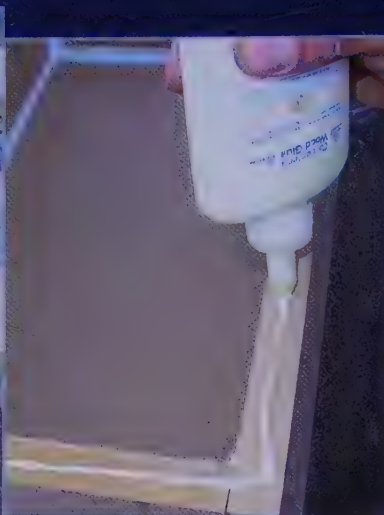
07

Trace an outline of the template supplied with the subwoofer onto the front panel. Be sure to center the cutout(s)

08

Using a jigsaw, carefully cut the holes for the subwoofers





09 Check the subwoofer for proper fit in each of the cutouts. The subwoofer should be a snug fit for a good seal

10 Run a bead of glue, then silicone along the front edges of the enclosure (we're applying the silicone here because it would be difficult to do it from inside the box, working through the holes)

Get a large piece of carpet and cut it roughly to size. Attach the carpet to the box using a spray glue and trim off any

12 excess, then use a razor blade to cut out the holes

13 Drill a hole for the speaker wire, then feed enough wire through for connection to the subwoofers





11

Align and attach the front panel to the box



Sub box hint

Insulating a sealed or ported subwoofer enclosure with poly-fill insulation will give you a bigger-sounding box. It does this by dampening the sound waves that are generated behind the subwoofer that would otherwise work against the movement of the speaker cone. If you're adding this to a ported box you'll have to devise some way of keeping the poly-fill inside so it doesn't blow out through the port. As a rule of thumb, use about 1 to 1-1/2 pounds of poly-fill per cubic foot of enclosure space.

Follow the manufacturer's instructions for connecting the subwoofer wiring, then place them into the enclosure and mount them, also

Using a hot glue gun, seal the hole where the wire comes into the box

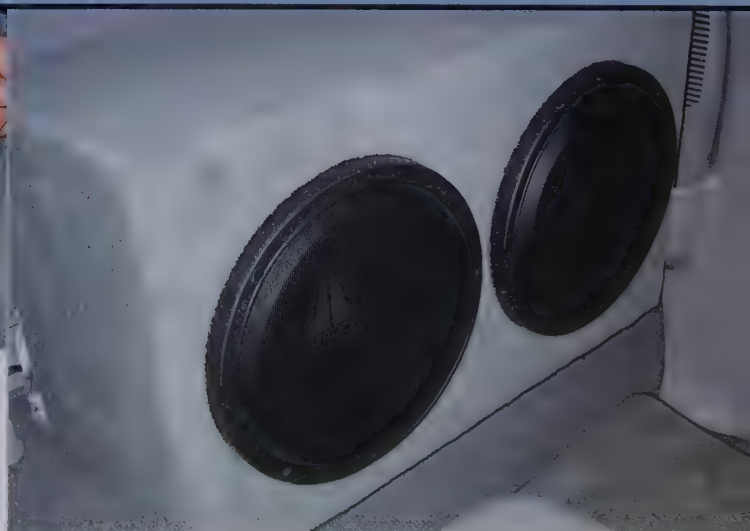
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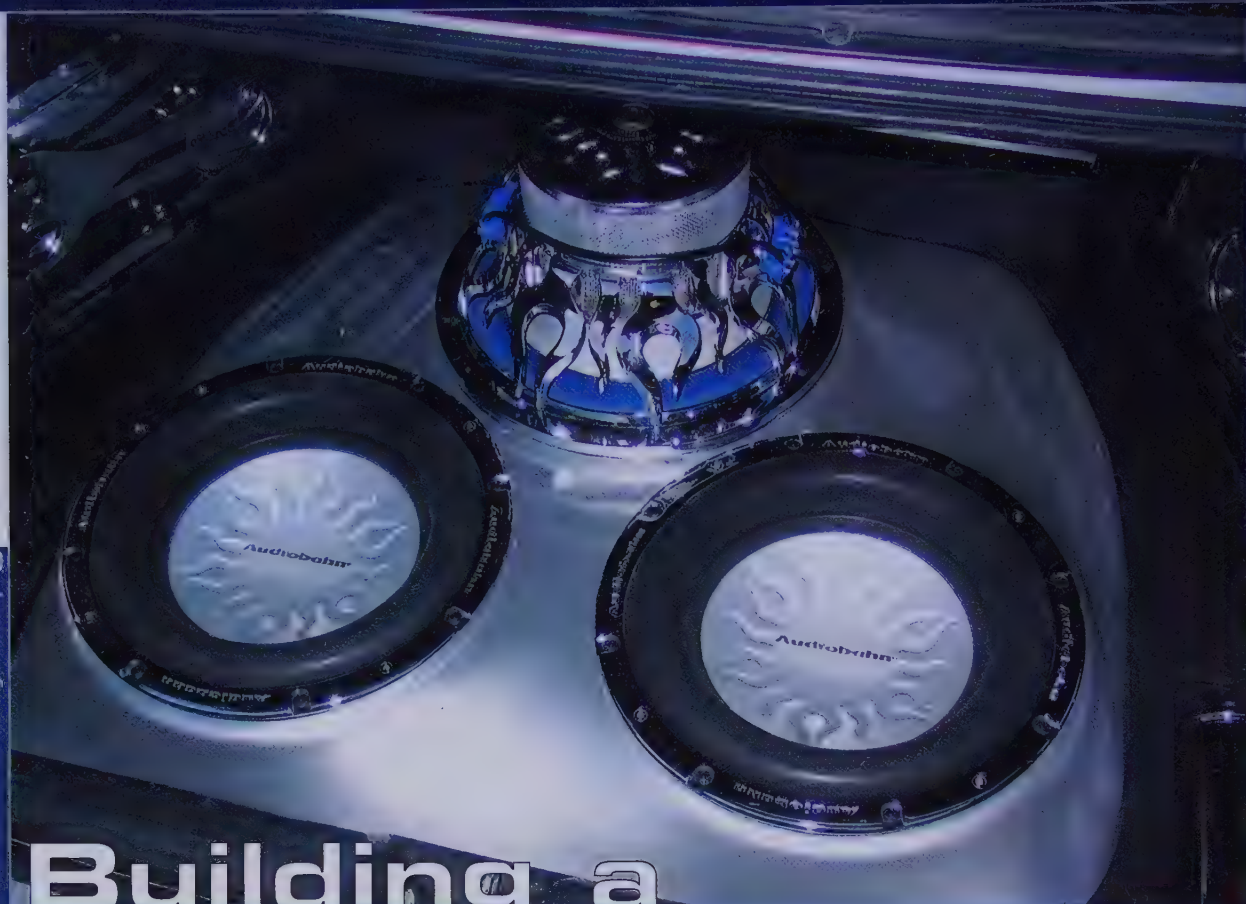
according to the manufacturer's instructions

15

Be sure to bolt the sub box down so it doesn't slide around. A loose enclosure can be dangerous, particularly in a crash. The last thing you want during an accident is half a ton of unhappy speaker and box hurtling towards you!

16





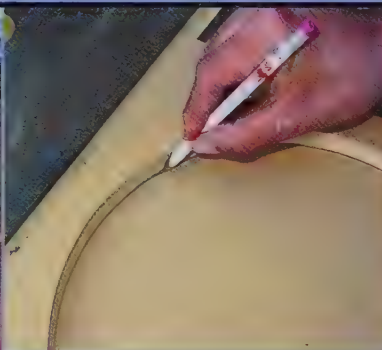
Building a fiberglass enclosure

The trunk area was stripped of the spare tire to make room for the enclosure and a support frame was constructed of 3/4-inch Medium Density Fiberboard (MDF)

01

02

Next it was time to measure and cut the rings for the subs





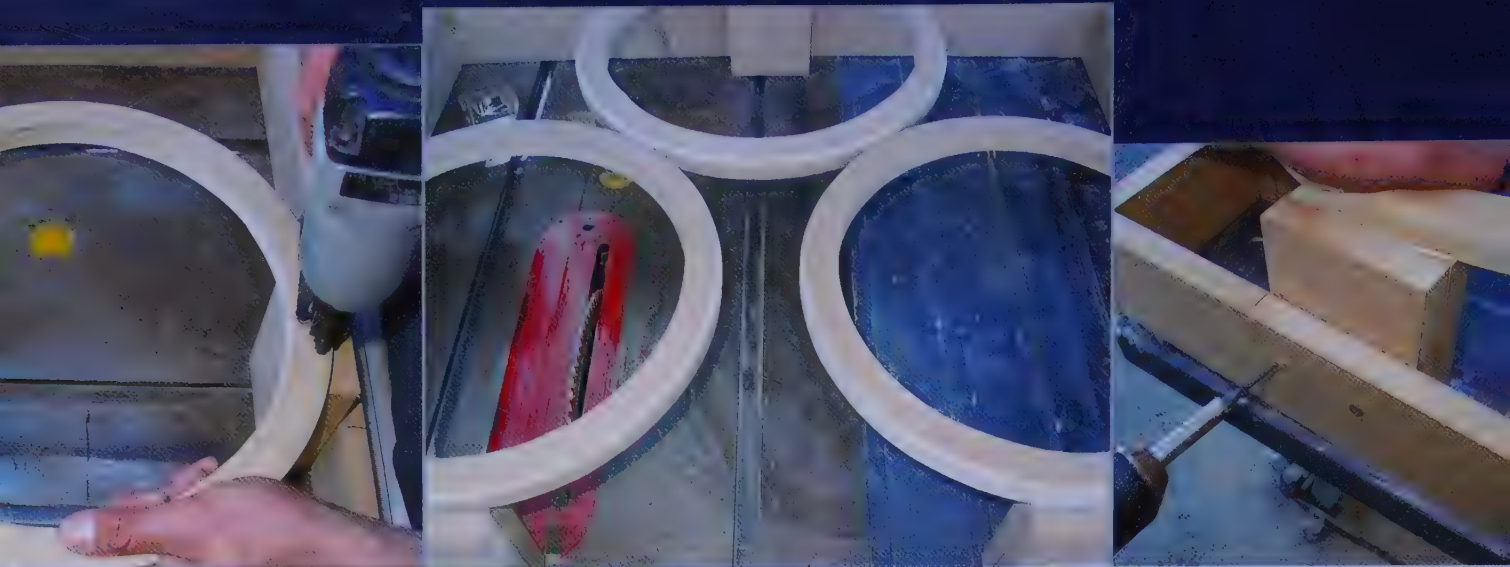
03

The rings are tried on for size, then taken to a router and some sanding to smooth out the rough edges. Wear a filtering mask before cutting MDF; it gives off an extremely fine dust which can be harmful to your health

04

Next, the supports for the sub rings are fastened to the frame using a nail gun; the rings can now be mounted

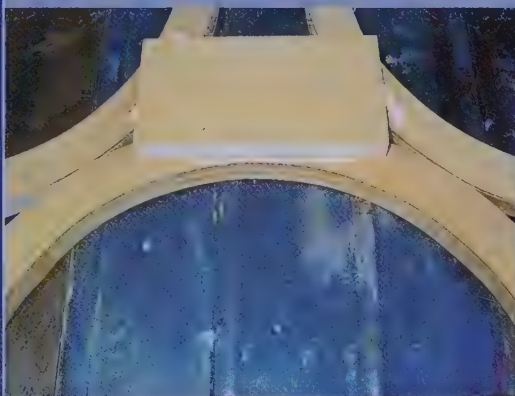




Subwoofers

04

Use screws to strengthen the supports



05

The rings are tied in the center by a piece of MDF glued to the bottom, then secured by screws through the top



06

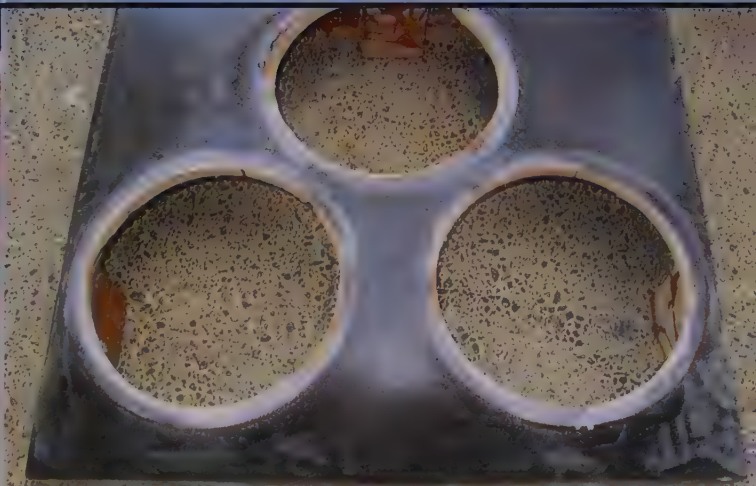
Speaker cover fabric is cut and stretched across the top of the box, then stapled to the sides of the box.

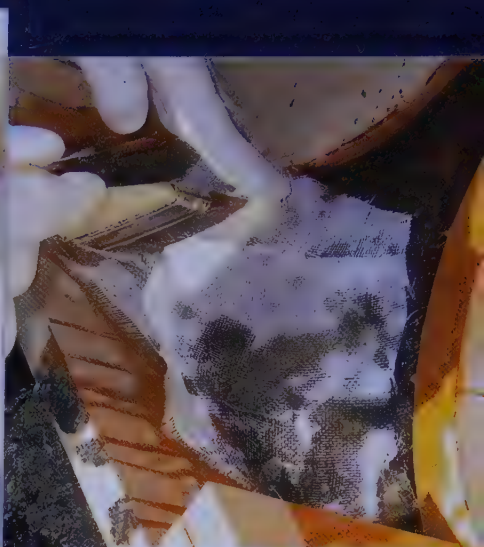
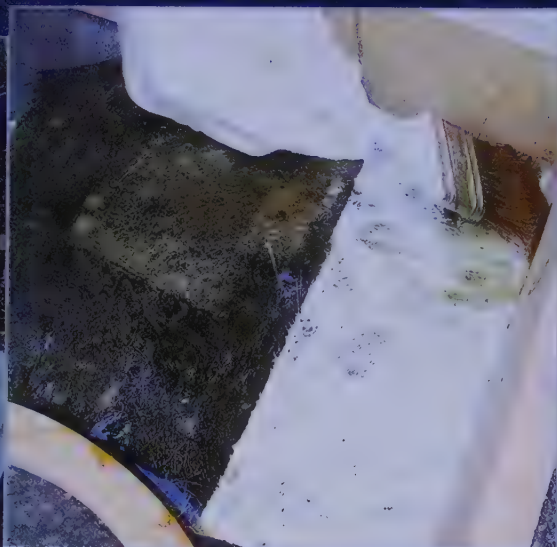
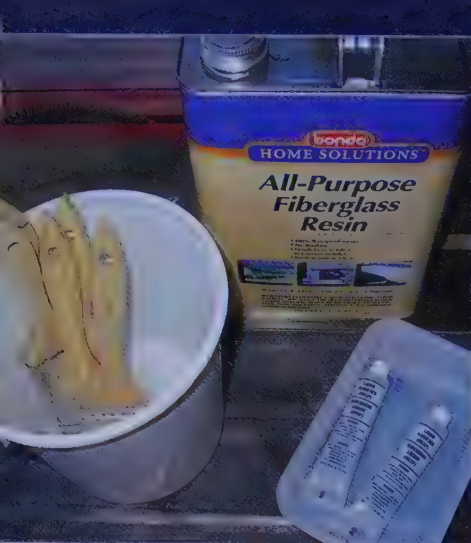
07

Time for laying down some 'glass' on the top of the box - this was accomplished by brushing a coat of resin onto the entire top of the fabric

08

After a few hours of drying time . . .





Subwoofers

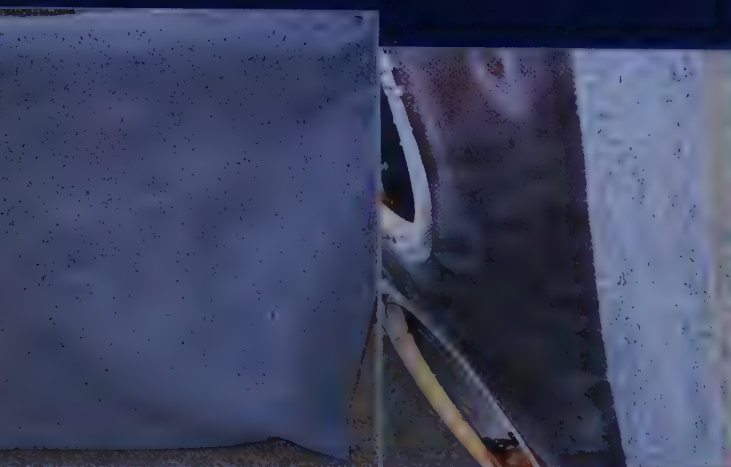
09

... the box is turned over, layered with fiberglass mat and brushed with resin

10

More drying time, then the inside is reinforced with steel mesh and body-filler





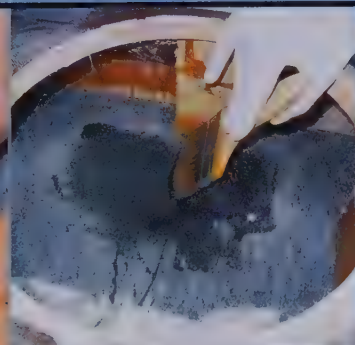
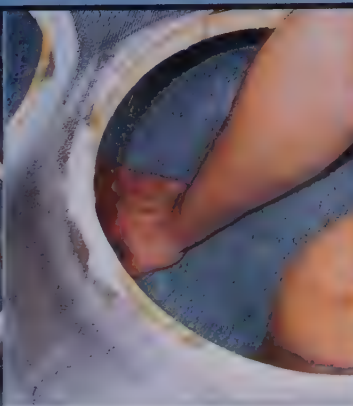
11 The next day a piece of carpet is attached to the bottom of the box ...

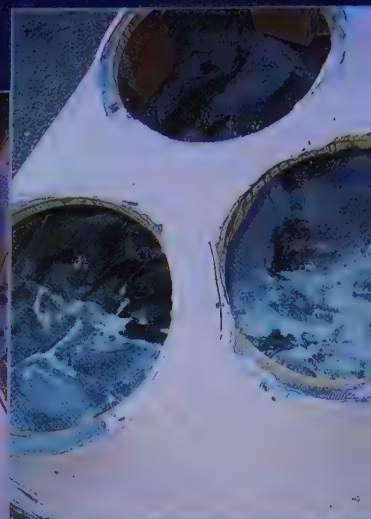
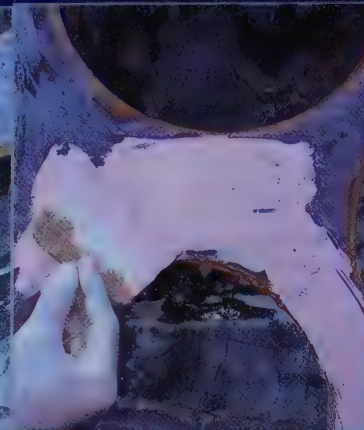


12 ... and a sheet of plastic is cut to protect the spare tire area

13 The box is placed in the trunk and the carpet stretched and formed to the bottom

14 'Glassing the bottom of the box, resin is applied to the carpet inside the box





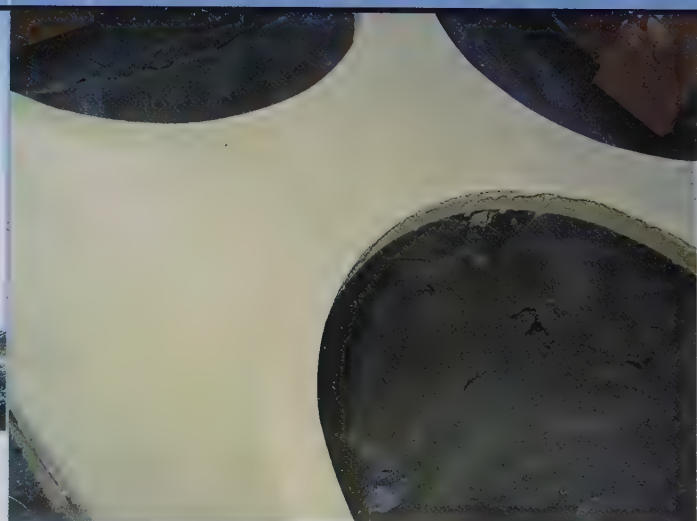
Subwoofers

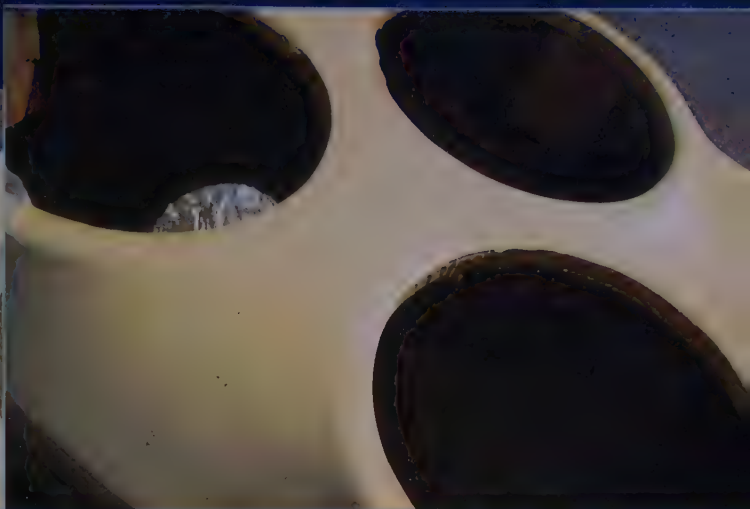
15 After several hours of drying time, the box is removed from the trunk and the top of the box is sanded. Be sure to wear the proper mask and eye protection

16 Then a coat of body filler is added to fill in any imperfections . . .

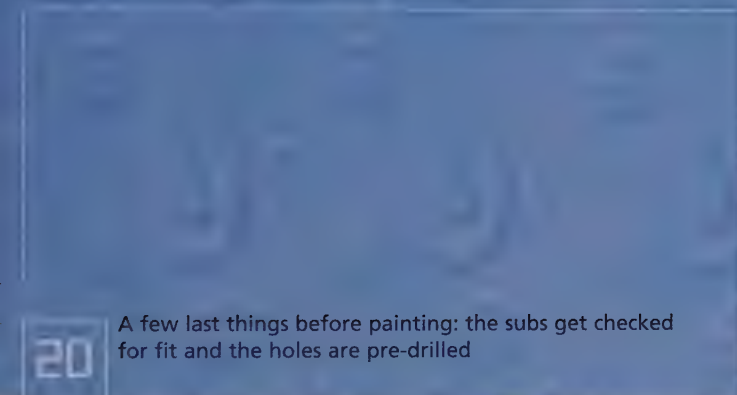
17 . . . and smoothed out with a grater and sandpaper.

18 A coat of primer is applied to the top . . .

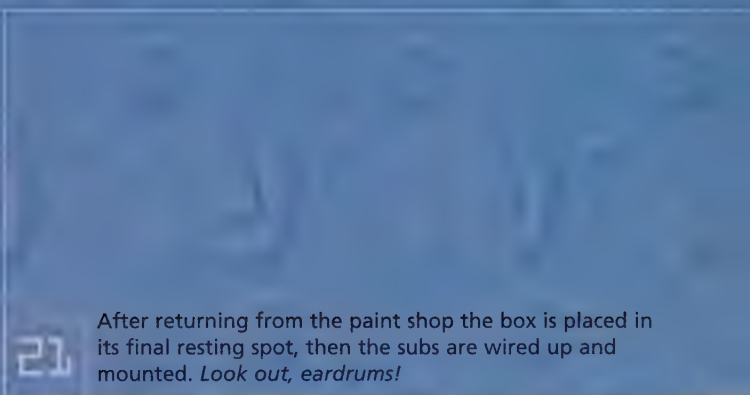




19 ... then sanded for a smooth surface that's ready for the paint shop



20 A few last things before painting: the subs get checked for fit and the holes are pre-drilled



21 After returning from the paint shop the box is placed in its final resting spot, then the subs are wired up and mounted. *Look out, eardrums!*



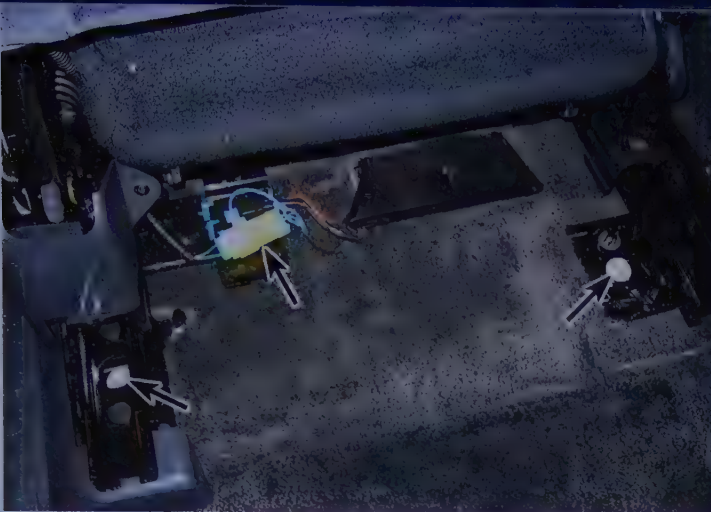
Vehicle specific enclosures

Some manufacturers offer ready-made, vehicle-specific sub-box enclosures. These are a convenient alternative for people not willing or able to construct a box, or for those who want a more factory look, sacrificing as little interior space as possible.

01

Handcrafted from fiberglass, the JL Audio Stealthbox will convert our center seat cushion and folding armrest into a sealed, downfiring subwoofer enclosure





02

The first thing to go is the seats. Most of the time, removing the seat is a simple matter of removing the four bolts securing the seat to the floorpan and lifting the seat from the vehicle. You may also have to disconnect an electrical connector or two. If your vehicle is equipped with side-impact airbags and/or seat belt pre-tensioners, you'll have to disable the airbag system (refer to the Haynes Automotive Repair Manual for your vehicle)

03

With both the driver and passenger seats removed, we lifted the center seat assembly out of the vehicle

04

Following the JL Audio installation guide, we disassembled the factory center-seat cushion and the upper storage tray. We saved all the upper tray's parts for use during reassembly

05

The center seat frame needed a bit of modification. Referring to the illustrations in the installation guide, we drilled each hole then checked the fit of the frame by placing it on the bottom of the Stealthbox





Subwoofers

06

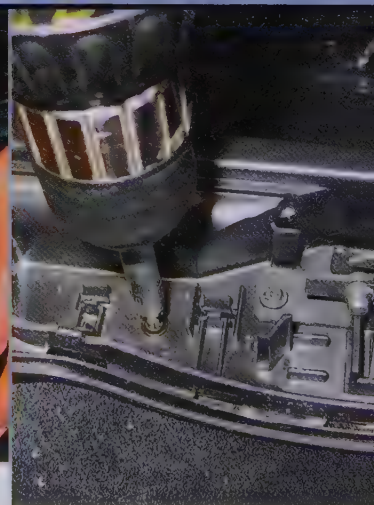
The frame was a perfect fit, so we attached it to the bottom of the Stealthbox with the supplied hardware

07

Before proceeding further, we attached speaker wires to the Stealthbox and tested its operation

08

Following the installation guide, we reassembled the latch, then secured the tray to the Stealthbox with the supplied hardware





09

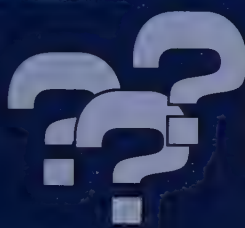
The Stealthbox was placed in the vehicle and the speaker wires were connected

10

Before installing the driver's seat we ran the speaker wire under the carpet so it could eventually be connected to the amplifier

11

The seats were installed to complete the installation. The finished Stealthbox is a perfect match to the factory interior and sounds great!



FAQs

Subwoofers

How big should my subwoofer enclosure be?

Information for matching the enclosure's size to the speaker's parameters should be included in the speaker's manual. Also, many speaker manufacturers provide this information on their websites.

When I construct my enclosure, what materials should I use?

Medium Density Fiberboard (MDF) is a good all around choice, easy to cut. Just be sure to wear a filtering mask (you don't want to breathe the dust from this stuff!).

What should I use to seal the enclosure?

Start by gluing all connecting edges, then use screws to complete the job. Finish it off by using silicone sealant along all of the interior joints.

What type of glue should I use?

A good wood glue is a safe choice.

What kind of silicone sealant should I use?

The same kind that you'd use for sealing a bathtub or shower (just make sure it's silicone sealant, not caulking compound).

How long should I let the glue and sealant cure before mounting the subs?

24 hours, because some chemicals may damage the some of the materials used in the woofers. And you want to make sure everything is completely dry and set-up, because the subs are going to generate a lot of pressure inside of the box.

How many screws do I need to hold the connecting edges?

Try using 2-1/2" screws every four inches.

How do I prevent the wood from splitting when using screws to fasten the boards?

Pre-drill the holes first.

05

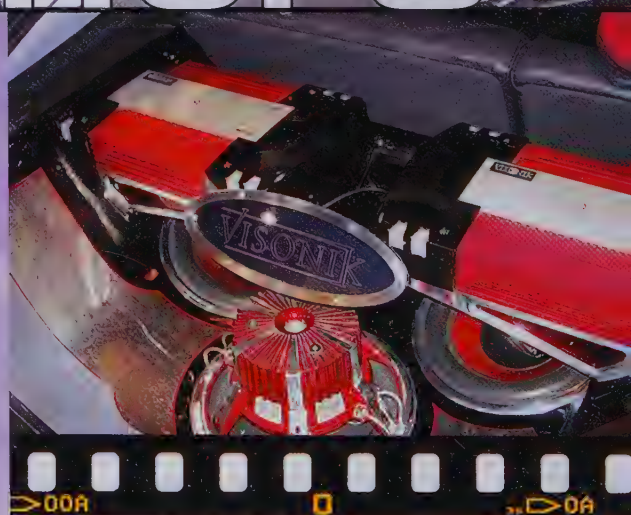
Amplifiers

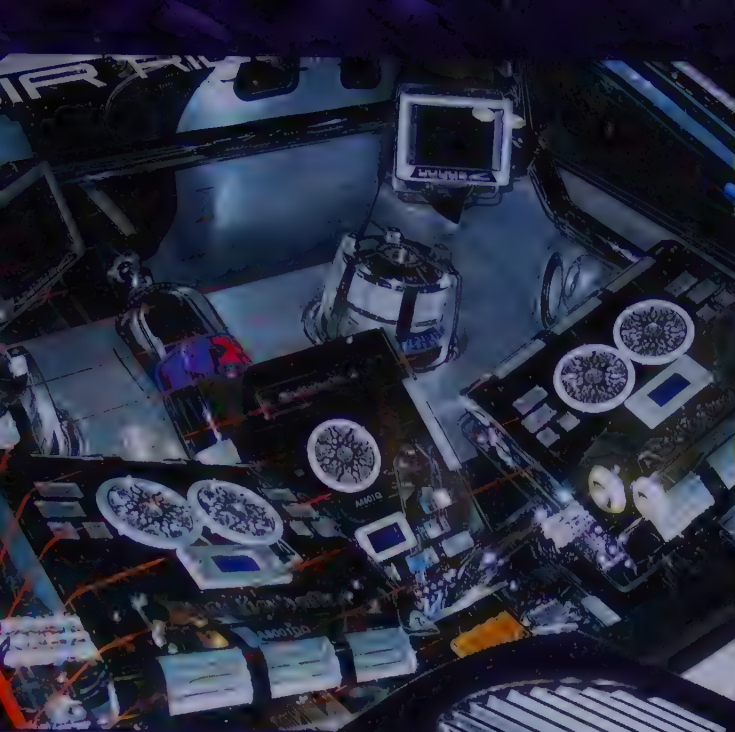


Amplifiers

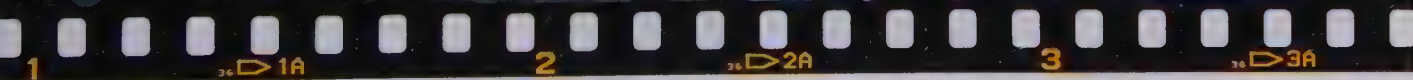
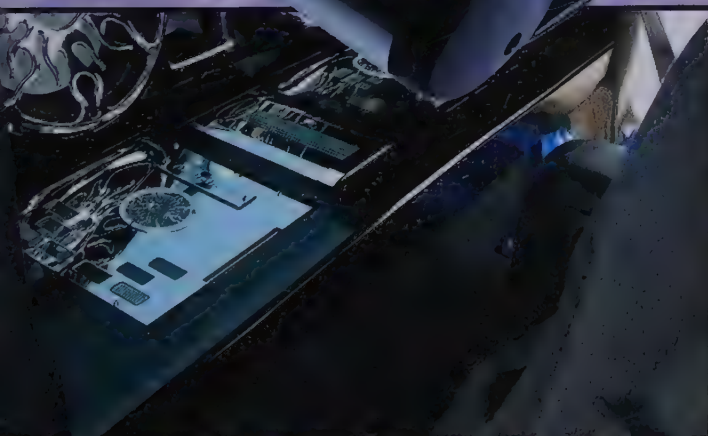
The powerplant of your system

Every decent car stereo system needs separate amplification. Even if you've got a head unit that claims it's kicking out loads of power, once you hook up an amplifier between it and the speakers, you'll be amazed at how much better a separate amp really is.



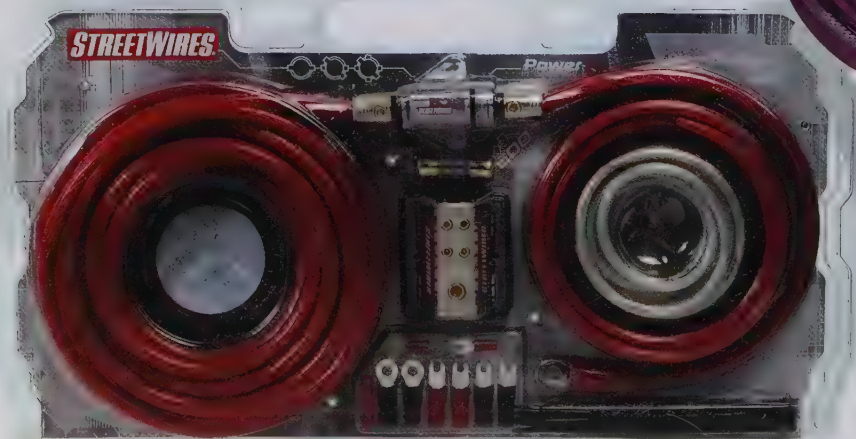


An amplifier is what drives your speakers. The problem is, the one in your head unit isn't very powerful; certainly not powerful enough to drive high-quality speakers and a subwoofer! In fact, most people add an amp because they are adding a subwoofer. An amplifier can be added to a factory system, too, which will greatly improve performance and sound quality.





When wiring up an amplifier, it's very important to do everything properly. The amplifier power wire must have a fuse mounted somewhere close to the battery, and be sure to use a grommet to protect the wire where it enters the passenger compartment. The signal cable from the head unit to the amplifier should be routed away from the car's wiring as well as the amplifier's power wire so that it doesn't pick up any nasty noise.



Lead photo: This amplifier fits nicely under the rear fold-up seat
Bottom and right: Amplifier wiring kits like these are available for making the job of installation easy



When the music is turned up and the car lights go dim, maybe an external capacitor is needed. External capacitors store power between the amplifier and the battery, providing extra power when necessary, eliminating an unnecessary strain on the vehicle's alternator or battery



How an amp works

The amplifier takes a signal and makes it larger without adding to, or taking away from, the original signal. To do this, the amplifier needs a power supply with a size proportional to the expected output. The car provides the amp with 12 volts in DC. The audio output will be in AC. The power supply of the amplifier takes the 12 volts from the car and steps it up. The voltage is increased substantially. The positive side will push the speaker and the negative side will pull the speaker as it reproduces music.

MOSFETs (Metal-Oxide Semiconductor Field Effect Transistors) are typically used in the power supply, and this is an acronym you should look for when shopping for an amp. MOSFETs can

control much more current than traditional FETs (Field Effect Transistors). This additional current handling allows amplifiers to operate at lower impedances over a greater temperature range.

Impedance is the resistance of a speaker to AC (music is alternating current). While 4 ohms is typical for car audio speakers, some applications call for putting two speakers in parallel, creating a 2-ohm circuit. Ohm's Law tells us that when the resistance falls, the power goes up. So the amplifier will attempt to produce more power when a low impedance is presented. The MOSFET technology helps the amp's power supply meet this demand.

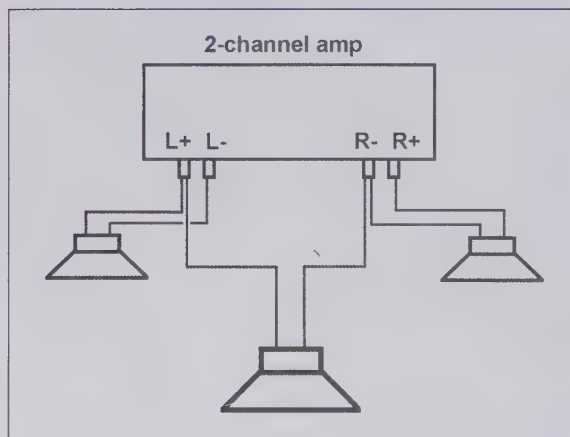
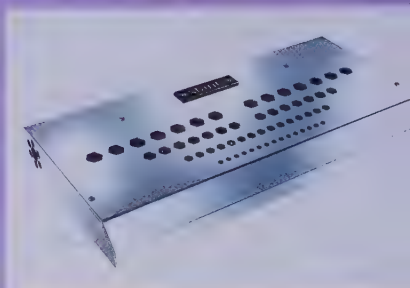


Some signal wires include a remote turn-on wire



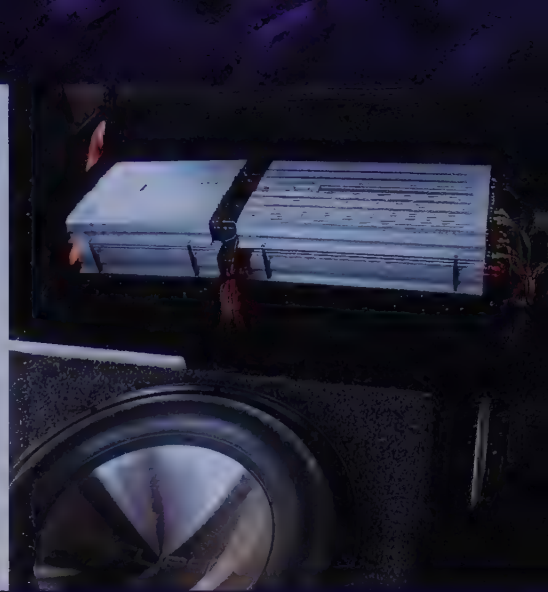
Channels

Anywhere from one to eight channels of amplified output are available. The number of amplifier channels is just as important as the output power for determining the right amp for your needs. Channels can be configured in different ways for different applications. For example, a four-channel amplifier can have two channels bridged while the remaining two channels operate in stereo. This creates a three-channel system. A two-channel amp can drive two speakers in stereo, while a third (subwoofer) is bridged across the right and left channels. A six-channel amplifier can have two channels bridged while the remaining four operate in stereo. Any number of combinations can be accomplished with multi-channel amps. For example, a four-channel amp is used in three-channel mode, where the low-pass crossover (which lets only the low frequencies through) sends bass to the mono channel for subwoofer input, while the remaining stereo signal is used to drive a pair of components in the doors in a high-pass mode.



What is bridging?

Bridging an amplifier involves using the left and right channel together to drive one or more speakers. Most modern 12V amplifiers are capable of being bridged. This process combines two channels to produce a higher power output to a single speaker or a group of speakers. Most (but not all) amplifiers today are made to be bridged. Caution: Amplifier manufacturers provide information on a stable limit for impedance in a bridged mode. For example, if an amplifier is only stable to 2 ohms in bridged mode, it is imperative that the speaker system does not present a load that is lower than 2 ohms.



Classes

There are different types of amplifiers. Amplifier classes indicate an amplifier's efficiency and sound quality. Typically, the more efficient the amplifier, the poorer the sound quality. For example, a high-power head unit has a very high-efficiency amplifier but is not known for its sound quality. If the output current flows over a longer amount of the cycle, the amplifier will be less efficient. On the other hand, if the output current flows over a shorter amount of the cycle, the amplifier will be more efficient.

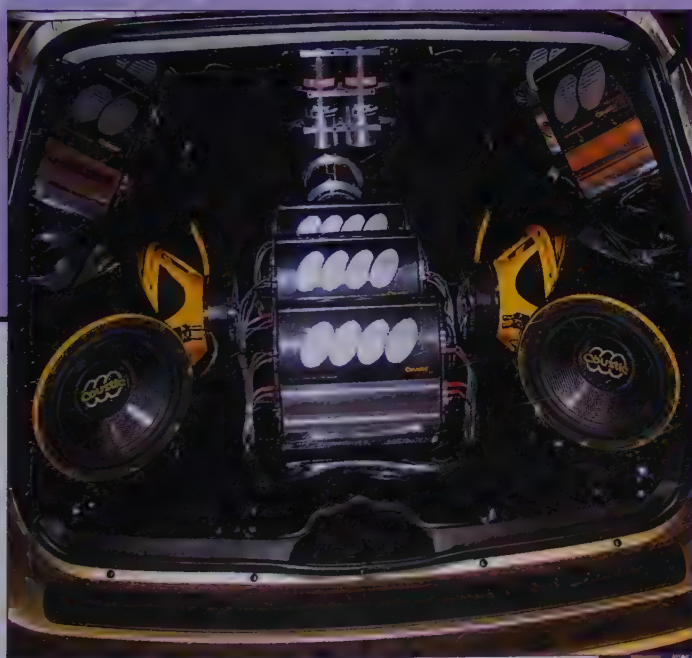
In simpler terms, if an amp uses 100 watts of battery power, but puts out only 50 watts, it is said to be 50% efficient. If it uses 100 watts of battery power, but puts out 80, then its about 80% efficient.

Class A: A Class A amplifier has a clean output, but poor efficiency. Most Class A amplifiers operate at about 20% to 30% efficiency. For example, if the amp requires about 100 watts of input power from the battery, it will only output about 20 to 30 watts of audio signal to the speakers.

Class B: This class of amps has twice the efficiency of Class A amps. Even though Class B amps might seem ideal, they cause audio distortion and are rarely used in car audio.

Class AB: Probably the most common 12V amplifier today, this amp provides good sound quality while maintaining efficiency. Most car audio amplifiers use a Class AB design.

Class D: The Class D amp is very efficient, but requires a complex output filter, which increases cost. The efficiency is due to the power supply following the input signal and adjusting itself accordingly. The Class D amplifier switches on and off hundreds of thousands of times per second. Class D is not a designation for Digital, as some literature may have you believe.





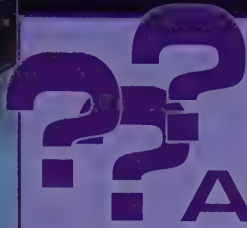
Amplifiers

Choosing the right amp

The first step is to determine the needs of your system. If you're just adding an amp to improve your original equipment system, you may need only minimal amplification. Therefore, a small inexpensive amp will suffice. On the other hand, if you're planning on running multiple subwoofers and component speakers, you'll most likely need multiple amplifiers.

Next, you have to figure out if you need an amplifier with a built-in crossover or an amp that is dedicated to playing a full-range signal. A built-in crossover can cross over different frequencies dedicated to a particular speaker, whereas a 12-inch subwoofer will sound best playing 100Hz and down. This will maximize the life of the speaker playing in this frequency range.





Amplifiers

Note:

If you're simply adding an amp between your factory head unit and speakers, look for an amp that has "speaker level inputs." This will allow your speaker level connections from the radio plug directly into the amplifier.

How powerful of an amp does your system need? Well, that depends what kind and how many speakers it has to drive. The amp should be capable of putting out 1-1/2 to two times the power (continuous, or RMS power in watts) that the lowest-frequency speaker that it'll be driving is rated. The specifications you'll find when shopping for an amp will indicate how many watts-per-channel the amp is able to produce continuously. This sounds weird, but an underpowered amp can actually damage your speakers when the volume is turned way up. The waveform it puts out changes from a nice curvy sine wave into more of a square wave, which speakers don't like; this is called *clipping*, because the top and bottom of the wave gets "clipped" off. The speakers can handle the extra power better than they can this ugly square wave.

Finally, how many channels must the amplifier have in order to interface with the stereo system? Say, for example, you're running four speakers and you want to add amplifiers to enhance the sound. You must decide if you want to retain the use of the fader. If you do, you will need to purchase a four-channel amplifier with four independent RCA inputs. A four-channel amplifier can run four speakers in a stereo fashion without losing fading capability.



When installing the amplifier's power wire, how close to the battery should I install a fuse or circuit breaker?

As close to the battery as possible. The MECP standard for fusing a power cable is no less than 10 inches from the battery terminal, but no further than 18 inches.

What is the minimum distance I should keep my signal wires separated from any power wires?

A minimum of 18 inches should separate power from signal.

Where can I mount my amplifier?

Generally an amplifier can be mounted anywhere there's room. Under a seat or in the luggage compartment are good locations as long as there's adequate ventilation. Mounting an amplifier upside down under something is not a good idea, though; as the amplifier produces heat, the heat will rise and have nowhere to go.

Where can I ground my amplifier?

The closer to the amplifier the better. This will help prevent any noise entering the system. Use a good ring terminal and be sure the contact point is free of rust and/or paint.

What size power cable should I use for my amp?

Follow the manufacturer's instructions included with the amp. Also take a look at the amplifier power cable chart later in this Chapter.

When installing multiple amps in my system, should I run a power cable for each amp to the battery?

One power wire connected at the battery should connect to a power distribution block. Separate power wires from each amp should then connect to the power distribution block.

Should I replace the factory battery cable clamp?

Yes. You will need to connect a power wire from the amp. A terminal clamp with an auxiliary adapter would be ideal.

What is the best way for connecting wires in the engine compartment?

Soldering the connection is best, and be sure to follow it with heat shrink tubing to insulate the connection and protect the joint from corrosion.

What if I have to run a wire through a hole in the body?

Always use a grommet.

What is a capacitor's purpose in a sound system?

The capacitors primary responsibility is to add stored energy to assist the vehicle's electrical system, based on how much current the amplifier needs. This provides for a more stable voltage supply and, in turn, enables the amplifier to run more efficiently.



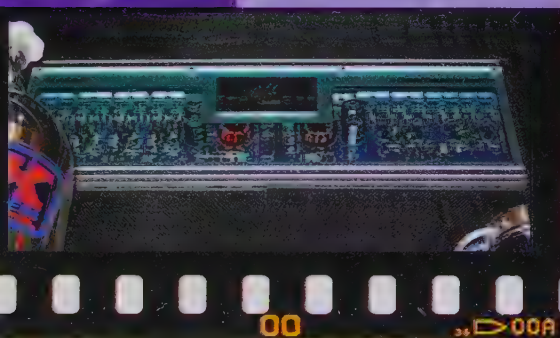
Upgrading considerations

Once you're familiar with what an amplifier can do, you may want to upgrade to a better amplifier or buy one that has more features. The number-one reason to upgrade to a better amplifier would be to have more power. High-pass, low-pass, and bandpass internal crossovers are another common amplifier feature. If you're adding a subwoofer to a factory system, then an amplifier with some type of low-pass crossover to block the high frequency from the subwoofer is needed.

Another upgrading consideration would be the number of channels the amplifier might have. If you

already have an amplifier operating two rear speakers, you may want to introduce more power to the front speakers. Upgrading to a four-channel amplifier to run the front and rear speakers would be an ideal way to make this improvement. Another alternative would be to simply add a second amp to drive the front speakers.

Size is a very important consideration when upgrading. Many enthusiasts want amps that can easily mount out of the way, under seats, walls, and floors of trunks.





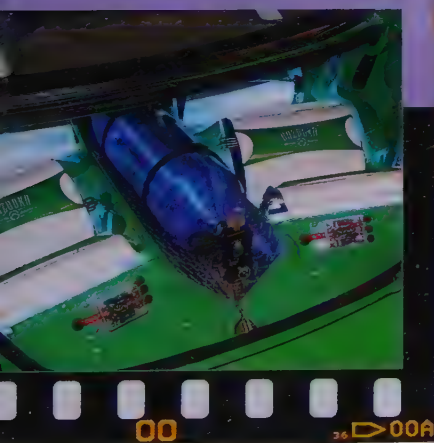
Using amplifiers effectively

Once an amplifier is installed, the level of the amp must be adjusted to match the rest of the system. The ideal setting is one where the maximum signal is being fed to the amplifier while introducing zero distortion. Some amplifiers have clip indicators, which illuminate when the input level is too high. If the gain control is too low, then one must turn the volume of the radio way up. This will amplify unwanted noises at this volume.

To improve the performance of some amplifiers, a stiffening capacitor can be added. A capacitor stores current, and when the amplifier demands more current (like when the subwoofer kicks

in real hard) it will pull it from the capacitor(s) instantly. This will result in increased performance from the amplifier. The capacitor must be placed as close as possible to the amplifier if it is to work properly. The size of the amp would determine the size capacitor to use. It is recommended to use 100,000 microfarads per 100 watts of power.

The condition of the vehicle's battery and alternator are also important to amplifier performance. If the amp isn't being fed what it needs, it can't possibly put out what you want.



Other items you'll need for amplifier installation

In addition to the amplifier(s), here are some items that you should pick up before you go back home to do the install:

- **Wire and cable** - Figure out how much cabling you need to connect your new amp to the battery, and how much speaker wire, also. Now would be the best time to upgrade your standard speaker wire to heavy-gauge speaker wire.
- **Connectors and solder** - Calculate how many connectors you'll need to hook up your amps and speakers, then buy a few more just in case. If you're using any connectors which require solder, use only resin core solder.
- **Shrink tubing** - If you're using connectors that have to be soldered to the wire or cable, get some shrink tubing to cover your solder joints. It makes for a much cleaner-looking installation than electrician's tape, not to mention a more secure and longer-lasting one.
- **Fuse holder** - Get a fuse holder with amperage rating high enough for your setup. This will have to be installed in the power cable, as close to the battery as possible.
- **Battery terminal** - Since you're going to be running a heavy-gauge cable from your positive battery post to the amplifier, get a new battery terminal with provisions for attaching one or more additional cable to it (if the terminal you have won't accept another cable).
- **Grommet** - If you have to drill a new hole in the firewall for your amp's power cable, this will protect it from chafing through the insulation and shorting out.
- **Power distribution block** - If you're installing more than one amplifier - you'll need one of these.
- **Mounting hardware** - What kind you'll need depends on where and how you'll be mounting the amp, but pick up everything you think you'll need before you actually start the job.



Note:

Many retailers sell amplifier installation kits that contain most of the items you'll need.



Amplifier mounting tips

An amplifier can generally be mounted anywhere there's room, as long as it isn't in a harsh environment or an area where it would get too hot. Under a seat is a good location as long as there is adequate airspace above the top of the amp, and so is in the luggage compartment. The one thing you don't want to do is mount the amp to the underside of something, such as underneath the package tray. This could cause the amp to overheat, because heat rises and in this case would have nowhere to go.

Always secure the amp properly, using any brackets that were supplied with the amp, and good quality fasteners. Make sure the surface that the amp is mounted to will support the weight of the amp, and won't "let go" of it in the event of an accident.

Whenever it becomes necessary to drill through the floor or a panel of the vehicle to mount an amp, make sure there's nothing on the other side that could be damaged by the drill bit or by the fastener that will be screwed into the hole.

Always use high-quality connectors. If you're using ring-type connectors, it's a good idea to solder them to the wire or cable to ensure a good connection that won't corrode. Tighten all fasteners securely.

Whenever you have to run a cable or wire through the firewall or other body panel, be sure to insulate the hole with a grommet. This is imperative, since it will prevent the wire's insulation from rubbing through and shorting out, which could cause a fire.

The fuse in the amplifier's power cable must be located as close to the battery as possible, and the fuse's amperage rating must be equal to or less than the amplifier's fuse(s).

The amplifier must be securely grounded, using the same gauge cable as the power cable. The amp's ground cable should be as short as possible; ideally, less than 1-1/2 feet.





Deciding where the amplifier is going to be installed is the first step. In this case, we've opted for mounting it under the front seat

Installing an amplifier

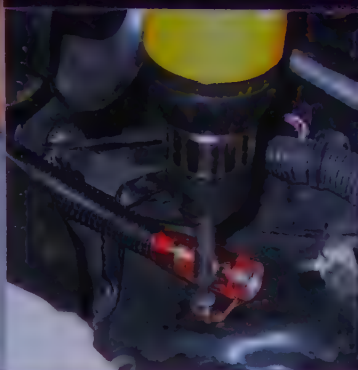


Warning: If you're working on an airbag-equipped vehicle, see the Warning on page 9 before starting this procedure.

Amplifier power cable chart

To avoid excessive voltage drop, be sure to use the proper gauge cable to power your amp(s). Remember, an amp needs a good voltage supply to work properly, so don't skimp in this department!

Current draw (in amps)	Distance from battery to amp						
	0 to 4 feet	4 to 7 feet	7 to 10 feet	10 to 13 feet	13 to 16 feet	16 to 22 feet	22 to 28 feet
0 to 20	14	12	12	10	10	8	8
20 to 35	12	10	8	8	6	6	4
35 to 50	10	8	8	6	4	4	4
50 to 65	8	8	6	4	4	4	2
65 to 85	6	6	4	4	2	2	0
85 to 105	6	6	4	2	2	2	0
105 to 125	4	4	4	2	0	0	0
125 to 150	2	2	2	0	0	0	00



02 Most of the time, removing the seat is a simple matter of removing the four bolts securing the seat to the floorpan and lifting the seat from the vehicle. You may also have to disconnect an electrical connector or two. If your vehicle is equipped with side-impact airbags, you'll have to disable the airbag system (refer to the Haynes Automotive Repair Manual for your vehicle)

03 Running the amplifier's power wire starts at the battery. The main power wire needs to have a waterproof fuse holder mounted as close to the battery as possible

04 Use a short piece of power wire between the battery and the fuse holder

05 Attach the other half of the fuse holder to one end of the short power wire . . .

. . . and crimp a terminal ring to the side that will connect to the battery



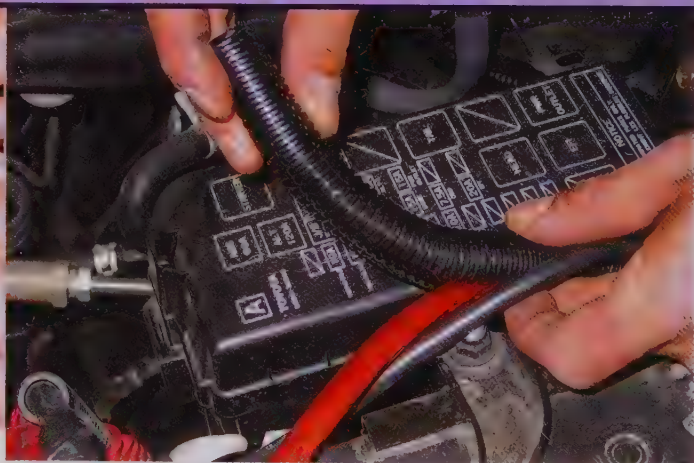


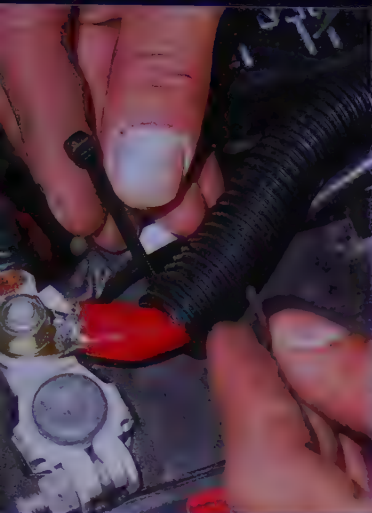
07 Connecting the power wire at the terminal is ok, just be sure NOT to install a fuse and complete the power connection until you finish the entire installation

08 The power wire now needs to be routed to the passenger compartment. How to get the wire through the firewall doesn't have to be a dilemma - just find an existing hole like this one . . .

09 . . . remove the grommet, cut a small hole in it and feed the power wire through the grommet and firewall. Be sure to refit the grommet to the firewall to prevent water leaks and to protect the wire

10 Inside the engine compartment, use split loom to cover and protect the entire power wire





11

Using wire ties helps keep the tubing from sliding off



12

Inside the passenger compartment, properly secure the power wire to prevent being tangled or getting in the way of the pedals



13

The carpet is pulled back and the wire is directed towards the amplifier's mounting location

Note:

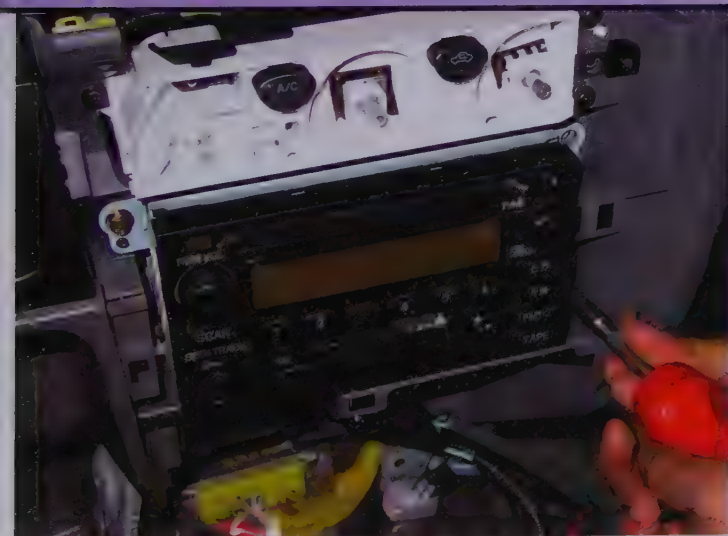
When routing the signal patch cables, keep them a minimum 18 inches from any power wire including any vehicle wiring harness

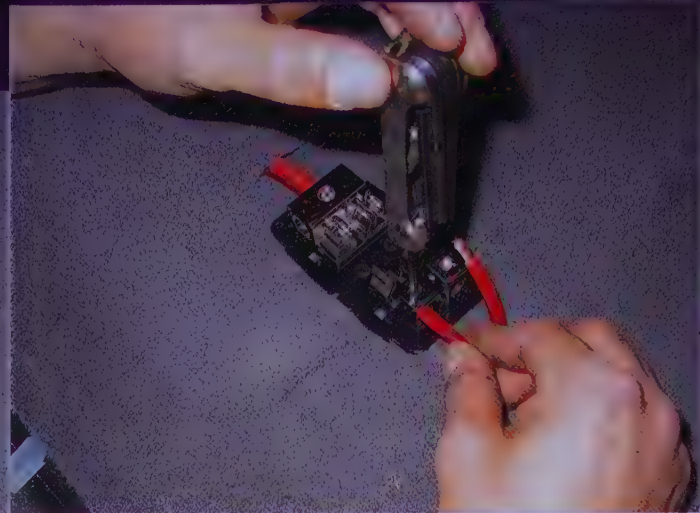
The amplifier's remote turn on wire and signal patch cable have to be connected at the back of the stereo head. Route the remote turn on wire in the direction of the amplifier's power wire where it enters at the firewall.

14

15

Route the amp's power wire and remote turn on wire together under the carpet - use wire ties or electrical tape to keep them tidy





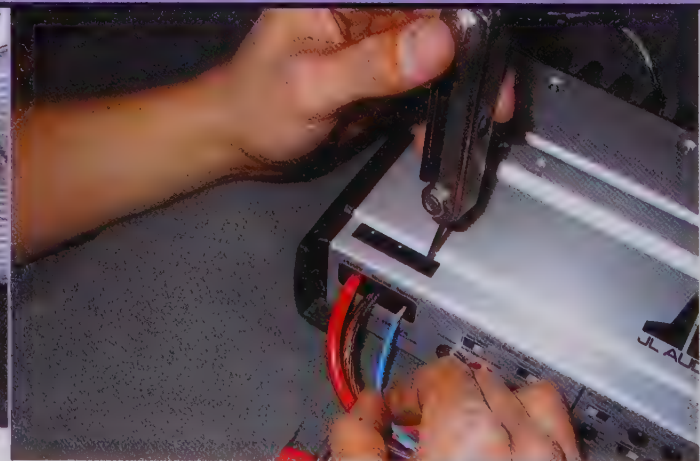
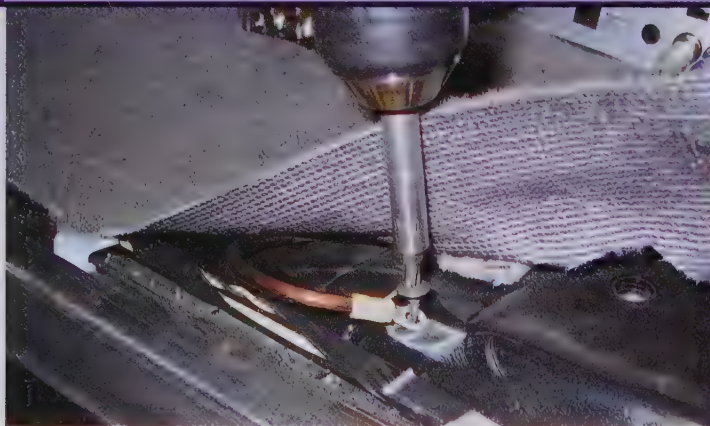
16 At the amplifier, a power distribution block can be used if two amplifiers are being installed

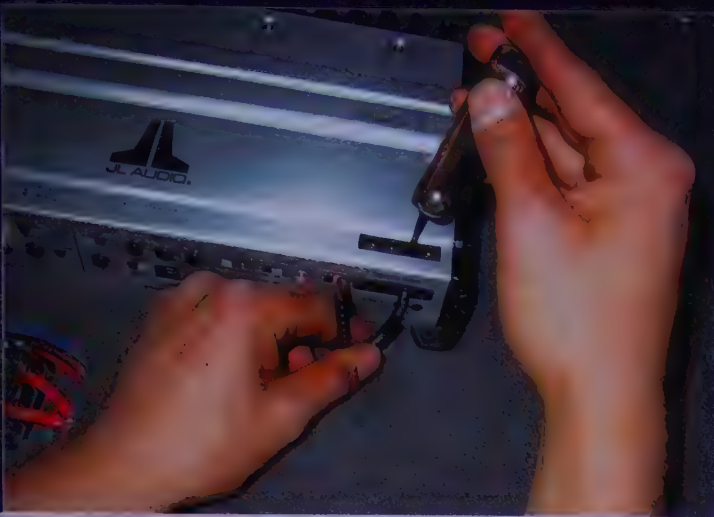
17 After securing the main power wire ...

18 ... two separate smaller gauge power wires split off to supply each amplifier

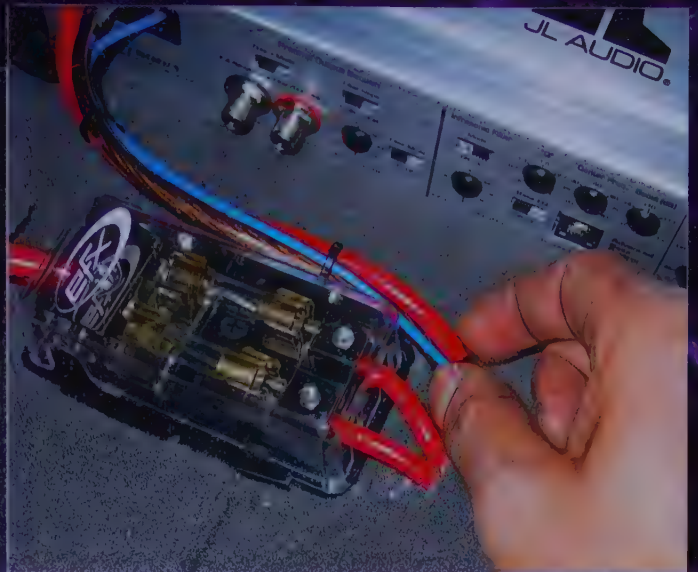
19 Cut a short length of wire for the ground and crimp a ring terminal on one end. Find a spot to mount it to the vehicle chassis. Be sure to sand off any paint so that the connection is made directly to metal

20 Connect the power cable, remote turn on wire and ground wire to the amplifier. With this amplifier from JL Audio, the wires connect directly to the amp using an Allen wrench without the need for terminals





21 The same is done for the subwoofer speaker wires



22 Wire ties can be used to keep the power, remote and ground wires together

Note:

Always follow the manufacturer's recommendations for mounting the amplifier. Properly securing an amp is very important so that it's not sliding around. A sliding amplifier that's not properly mounted can damage the unit, or worse, be dangerous during an accident. The last thing you want during an accident is a UFO (unnecessary flying object) inside the passenger compartment!

23 Connect the signal patch cables to the amplifier



24 With the installation complete it's time to install the fuse and test the amplifier. Carefully follow the manufacturer's instructions for powering up the amp and making any necessary adjustments



06

CD Changers and digital music players



CD Changers and Digital Music Players

The perfect companion for a long trip, or when you just don't want to hassle with the radio or individual CDs or tapes, a CD changer or digital music player stores hours of your favorite tunes. The ultimate "front-end" to your sound system.



Kenwood USA Corp.



The Blaupunkt IDC-A09 is an in-dash multiple choice five-disc CD changer

CD changers

A CD changer can enhance your audio system while offering many options such as random and repeat play, and the capability of adding titles to the discs. They are fairly easy to install because their compact design allows mounting virtually anywhere in the vehicle and connection is straightforward. There are three basic types of CD changers, distinguished by how they are connected to your audio system:

- *Direct connection*
- *FM modulated*
- *Auxiliary input*

Direct connection

This installation involves connecting a cable between the CD changer to a radio head unit of the same brand (or a radio head with CD changer control capability and compatible with the CD changer). Many late-model original-equipment head units have a factory option to accept a changer.

Original equipment changer controllers typically use the same cable as their aftermarket version, making it easier to connect a compatible changer to the head unit. This type of installation is so popular that manufacturers also offer "plug and play" cable adapters compatible with the factory head units.



FM modulated

FM modulated (also called RF [radio frequency] modulated) CD changers are popular installations because they only involve adding a changer, an FM modulator and a remote mounted control unit. It isn't necessary to replace the factory head unit because the changer is designed to convert the CD signal to an FM frequency and play through the existing FM radio head unit.

The only drawback to the FM modulated is that sound quality is limited by the radio's reproduction ability, but the ease of installation makes this one of the most popular routes to take when choosing a CD changer.

Auxiliary (AUX) input

Because it connects by cable to an existing head unit as an additional (auxiliary) source, this is probably the easiest CD changer installation. Most of the wiring is already done because the necessary switching functions are usually built into either the head unit or a downstream pre-amp level processor.

AUX inputs usually have a 5-pin, 8-pin or 13-pin female DIN connector on the back of the head, and many mobile electronics stores carry reasonably priced wiring adapters. Since the internal selector already has an AUX position for the auxiliary source, the input selector can choose between the head unit's tuner, tape or auxiliary input. The factory head unit can't control the functions of the auxiliary source, so a separate controller is required for operating the CD changer.



What should I look for?

When deciding on a CD changer you'll have to weigh its features against its price, then figure out what's best for your needs. Typically, CD changers are available in 6-disc, 10-disc and 12-disc models (those are the most common, anyway), so you'll have to determine how much music play-time and variety you want.

Once you've made that decision, check out the technical specs. Does the unit play CDs that you've burned from your home computer? Most of them do, but check to make sure - it's nice to have the ability to be able to load store-bought CDs along with CD-Rs or CD-RWs burned with MP3 files into the changer without having to think about whether or not they'll play when it's their turn!

Another convenient feature is the unit's ability to display information on the control head that mounts on the dash. This will let you know the artist and song title as the song plays.

Wireless remote - This is another good feature to have, although not completely necessary. It'll simply prevent you from

having to reach up to the instrument panel to browse through your discs and tracks.

Electronic shock protection - This feature incorporates digital memory into the playback circuitry, which will ensure uninterrupted play if you hit a hard bump that would cause the CD to "jump." This is a huge improvement over the early CD changers and another attribute worth looking for.

Make sure the unit is able to be mounted where you want to put it; not just size-wise, but in its orientation. Is it able to be mounted flat as well as vertical, or somewhere in between? Figure out your mounting requirements before you start shopping.

FAQs CD changers

What features prevent CD skip?

CD changers with Electronic Shock Protection provide a memory buffer that reads ahead and stores a bit of the information a few seconds ahead of what you're hearing.

Can I connect any aftermarket CD-changer to my factory head unit if it has CD-changer controls?

That depends on the availability of OEM interface CD changer adaptors. With some applications it's as easy as connecting the CD changers connector to the adaptor, then to the factory harness.

What if my head unit doesn't have CD-changer controls?


You can integrate an FM modulator to control the changer.

What are CD-R and CD-RWs?

With a CD-R disc the R stands for "recordable" enabling you to permanently record one time to the disc. A CD-RW disc allows the user unlimited amount of times they can record and erase information from the disc.

Can my CD player play MP3 files burned on CD-R or CD-RWs?

Only if the player is MP3 compatible and has an MP3 decoder.



The Blaupunkt MDP-01 compact drive can hold the equivalent of 15 CDs of digital music

Digital music players

The new generation of music isn't pressed onto vinyl or recorded on tape; it's digitized as a computer file and downloaded. So how do you take that music with you on the road? A digital music player for your car.

Like CD changers, digital music players also make possible the ability to carry a huge amount of music on the road, but without having to touch a single CD. Furthermore, some units allow you to organize your music in a variety of ways; by genre, artist, or album, for example. Most digital players can recognize all of the popular digital music formats - MP3, WMA, WAV and ATRAC3 files.



Types of digital music players

CD/MP3 head unit

The simplest type of digital music player is a stereo head unit that plays CDs burned with MP3 music files. This is an economic way to play lots of music continuously without adding a CD changer or a remote digital music storage device.

In-dash hard drive

Another type of head unit that'll play digital music is the in-dash hard drive. Memory capacity varies amongst these units, but most will hold (at the time of writing) around 10-gigs worth of music. These units will allow you to copy music from your CDs, CD-Rs or CD-RWs right onto the hard drive. Some also have "memory stick" media which allows you to download music from your computer right into the memory stick. You then plug the memory stick into the head unit, bypassing the CD altogether.

Remotely mounted hard drive

The most popular type of add-on digital music player is the remotely mounted hard drive which connects to your system just like a CD changer. In the most common version, a removable hard drive is unplugged from the unit and plugged into a docking station connected to your home computer. You can then download music files to the drive, transfer it to the player, and take a long road trip without hearing the same song twice! Another variation of this setup works in a similar fashion but bypasses the part about transporting the hard drive from your vehicle to your home computer; it does it wirelessly. A transmitter connected to your computer will beam songs right out to the hard drive in your vehicle up to about 150 feet - even through walls!

Common types of digital music files:

WAV files

An uncompressed audio file format that contains CD-quality audio which require large amounts of your computer's disk space for storage.

MP3 files

Internet-standard encoding format that compresses audio into a small file for storing on a computer.

MP4 files

The latest audio file compression that resembles CD-quality when compressed at 128 kbps (stereo).

Windows Media Audio (WMA)

High-fidelity compressed music file that is smaller in file size than MP3 compression.

ATRAC 3 files (Adaptive Transform Acoustic Coding)

A Sony-developed file compression format that was first used for MiniDiscs, and now includes memory sticks and some hard-disk drives. ATRAC 3 files cannot be burned to CD-R/RW discs.





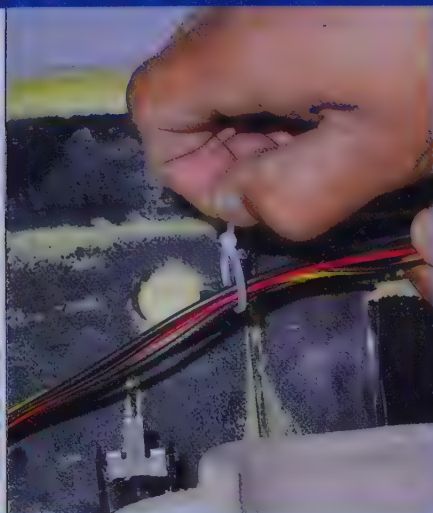
Digital music player with an FM modulator installation

01 With the battery disconnected, remove the stereo head unit to gain access to the antenna cable and electrical connectors

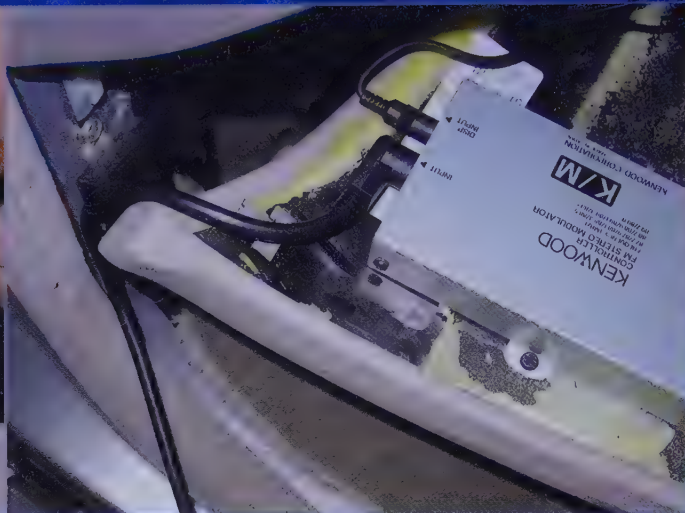
02 Find a mounting location for the FM modulator (for example, under a front seat, inside or under the glove box). With this vehicle, the modulator is being mounted behind the driver's side knee bolster. When attaching the modulator unit, be sure the screws don't poke through the outside of the bolster. If necessary, use smaller screws

03 Find a suitable place to connect the modulator unit ground wire to a good grounding point





04 Use wire ties to keep wires neat and together



05 Connect the display unit cable and the digital music player cable to the modulator

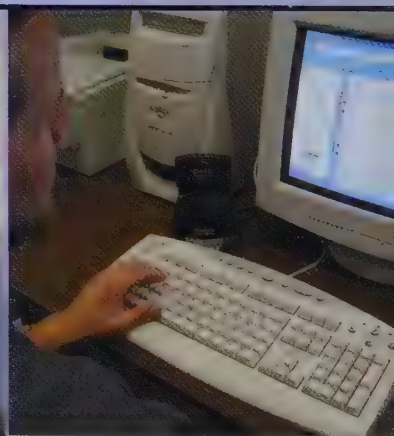
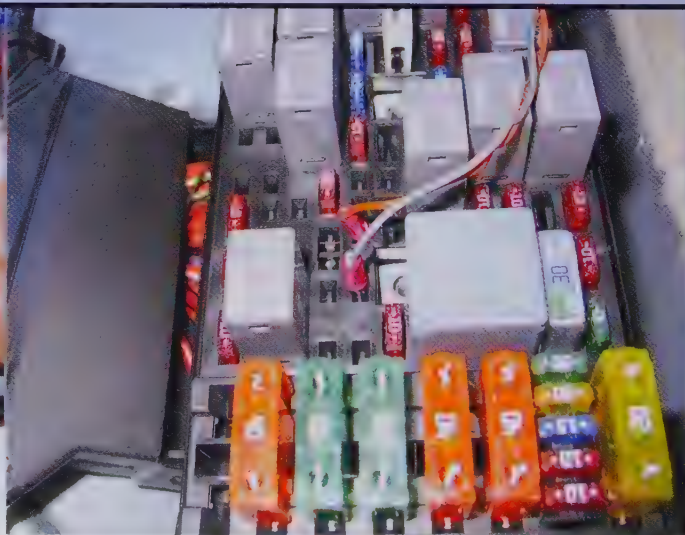
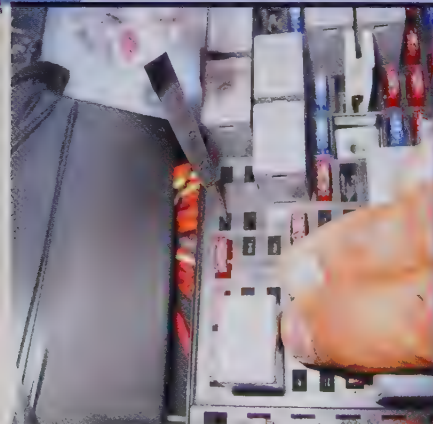


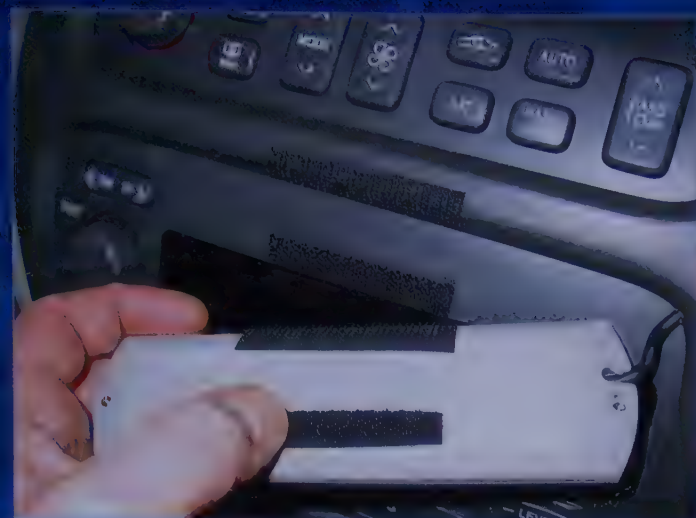
06 At the back of the stereo head unit follow the manufacturer's instructions and connect the vehicle's antenna cable to the modulator's antenna input, then connect the modulator output cable to the head unit's antenna input. Mount the head unit back into the dash

Follow the manufacturer's instructions for connecting the power wires. Here we used a test light to find accessory power in the fuse block ...

... then connected the B+ power and ignition (switched) wires

Connect the docking station to your PC and, using the supplied software, download your favorite tunes

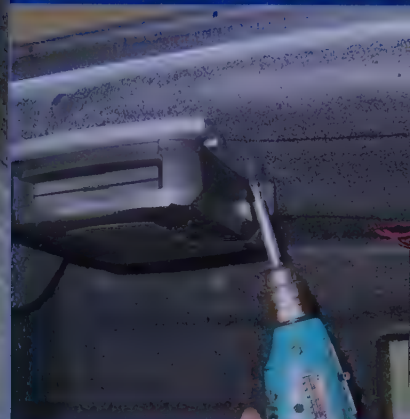




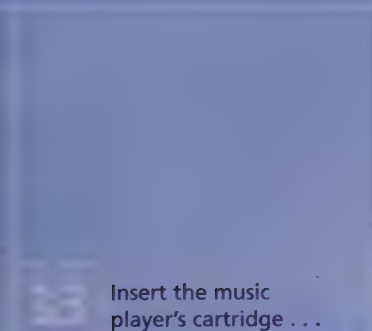
07 Follow the manufacturer's instructions for mounting the controller unit. Here we mounted the controller in a convenient spot using the supplied Velcro strips



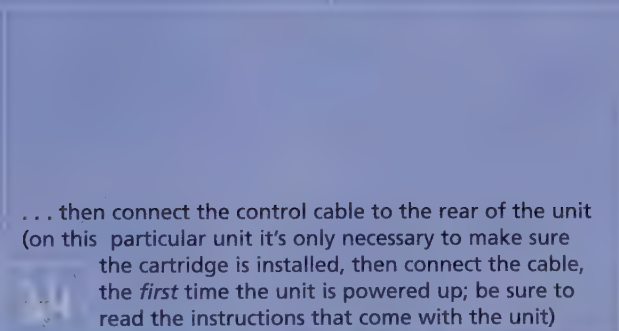
08 Remove the sill plate and run the music player's control cable to the trunk, under the carpet. If necessary, remove the rear seat and find a suitable place for the cable to enter the trunk space



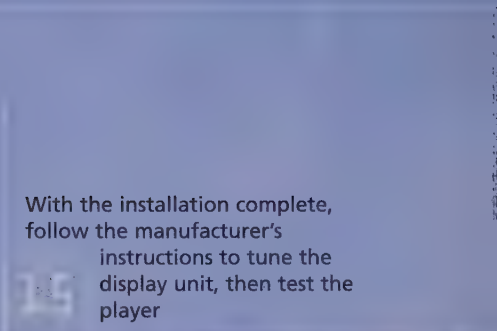
09 Follow the manufacturer's instructions for mounting the music player. In this application we mounted the unit in the trunk to the trim panel below the package tray, using the included self-tapping screws



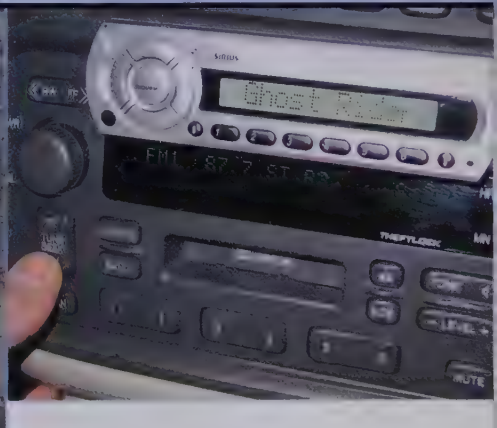
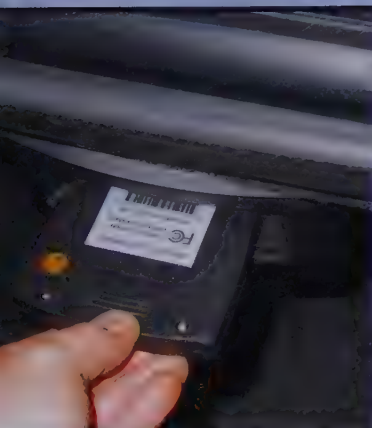
13 Insert the music player's cartridge ...



... then connect the control cable to the rear of the unit (on this particular unit it's only necessary to make sure the cartridge is installed, then connect the cable, the *first* time the unit is powered up; be sure to read the instructions that come with the unit)



15 With the installation complete, follow the manufacturer's instructions to tune the display unit, then test the player



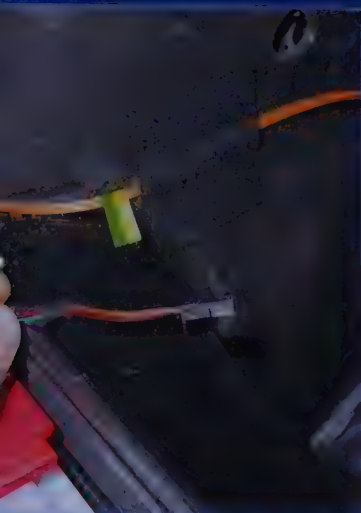


Factory CD changer installation

Many vehicles come from the factory pre-wired for a CD changer. The changer is often installed by the dealer at the time of the original sale and usually at a steep premium. But you can add your own factory changer in no time and save the installation fee in the process. So how do you know if your vehicle is pre-wired? Check the factory head unit. If it has CD controls, you probably have a wiring harness just waiting to be plugged into your new changer. Check your owner's manual to find out where the changer should be mounted and where the wires are hiding.



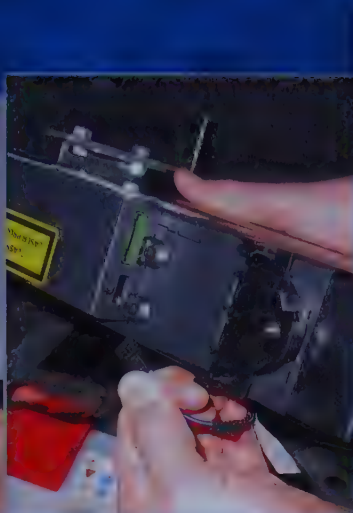
- 01** After finding the mounting location, we had to remove the fenderwell trunk liner and locate the factory installed signal/control cable . . .



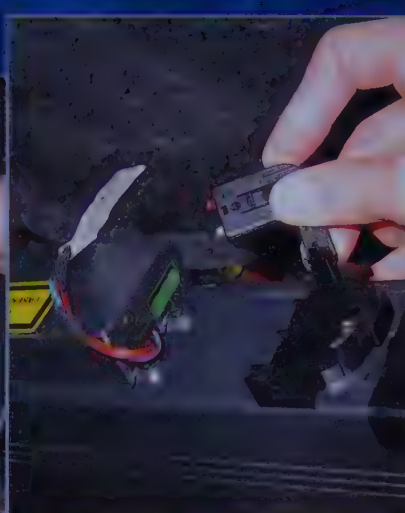
02 ... and the power cable for the CD changer



03 Attach the mounting brackets to the sides of the changer



04 Connect the power cable ...



05 ... and the control cable to the CD changer



06 Carefully lower the changer into the mounting location and install the mounting screws into the pre-punched holes



07 Reinstall the trunk liner.



08 Check to see if the changer's magazine can be inserted and removed smoothly from the changer



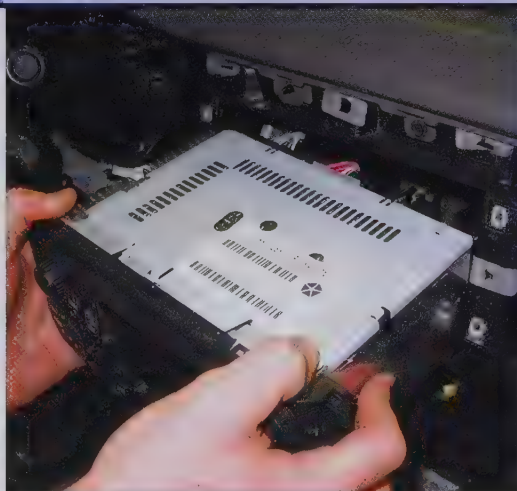


CD changer with an FM modulator installation

With the battery disconnected, remove the stereo head unit and disconnect the antenna and power connectors

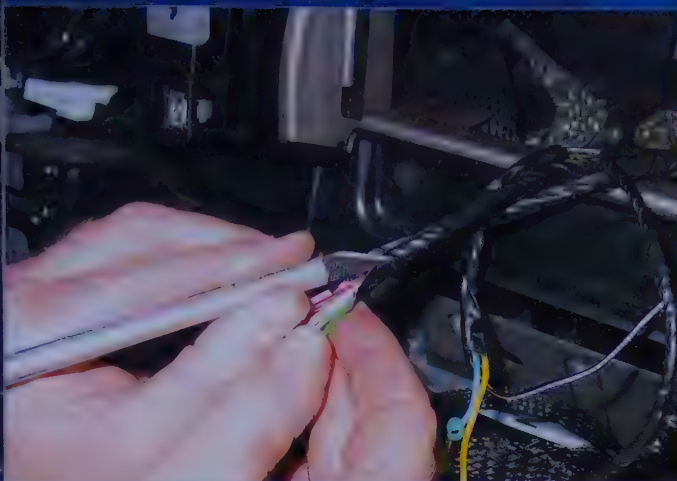
Find a suitable mounting location for the FM modulator (for example; under a front seat, inside or under the glove box). With this vehicle, the modulator is being mounted in the space below the radio, behind the instrument panel structure

Mark, then carefully drill the holes for the modulator mounting screws

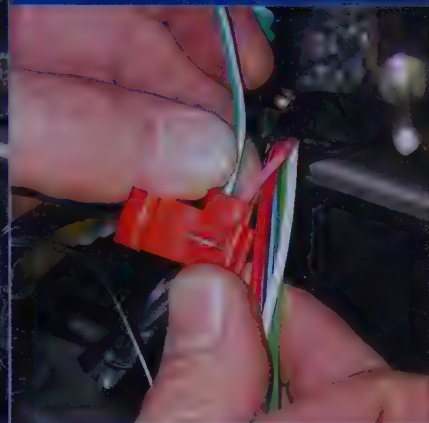




04 Follow the manufacturer's instructions for connecting the power wires for the FM modulator. Here we consulted the wiring diagram in our Haynes manual and found B+ power and accessory (switched) wires with a test light (this is at the head unit electrical connector)



05 If necessary, carefully cut back some of the wire harness tape to give yourself some working room



06 For convenience, the connections for the B+ power wire and accessory (switched) wire were made using Scotchlok connectors. Be sure to check that the connectors are compatible with the wire gauge sizes

Using electrical tape, secure the wires together for a neat and clean finish

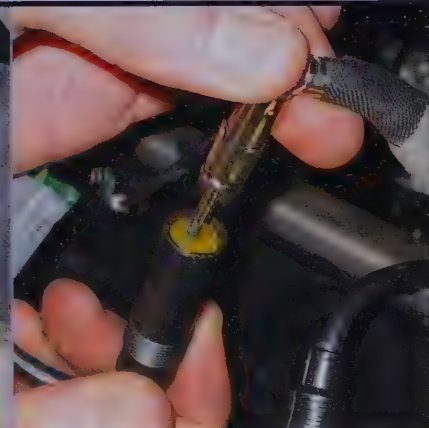
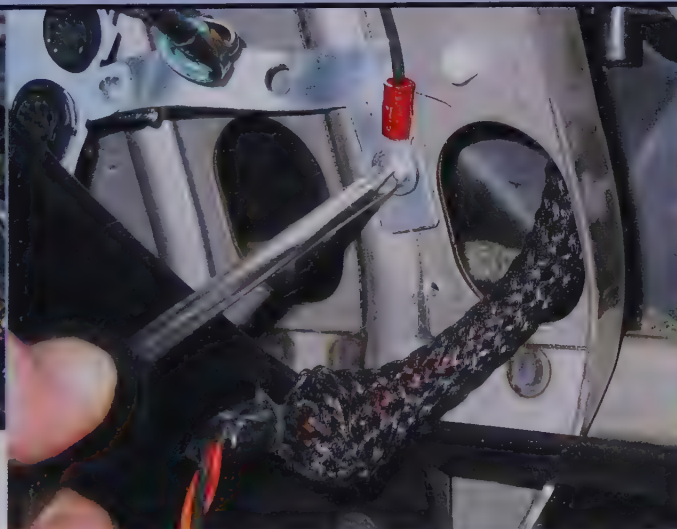
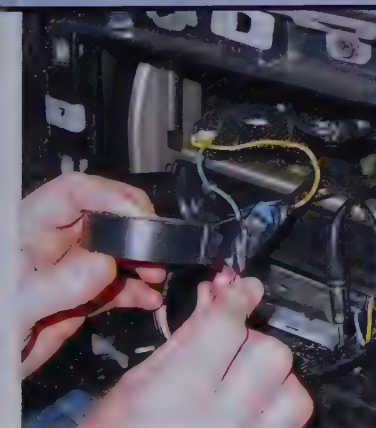
07

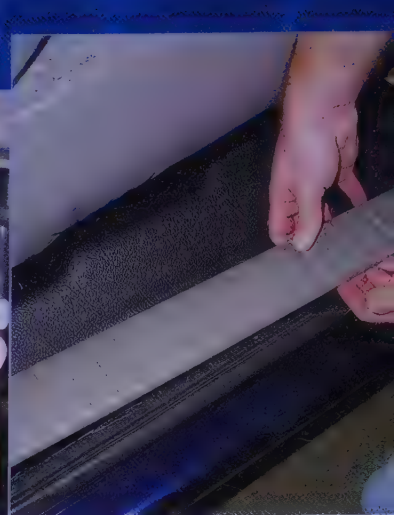
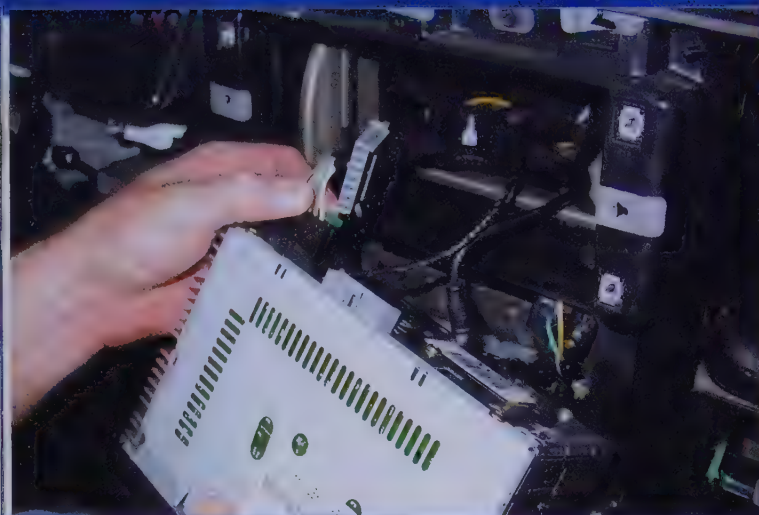
08

Find a suitable place to connect the modulator unit ground wire to a good grounding point

At the back of the stereo head unit, follow the manufacturer's instructions and connect the vehicle's antenna cable to the modulator's antenna input, then connect the modulator output to the head unit's antenna input

09





10

Reconnect the radio connectors . . .

11

. . . and mount the head unit back into the dash

12

Run the control wire to the changer's mounting location. We removed the sill plate . . .

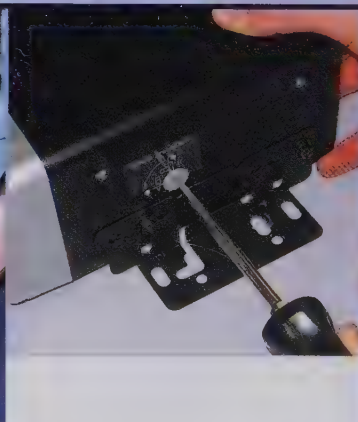
16

. . . then drilled holes for the mounting bolts . . .

. . . and bolted the brackets in place. Notice how we reinforced the backside of the panel with a thin board to make for a secure mount

Be sure to adjust the changer's horizontal/vertical screws (if equipped) to the proper setting

After installing the trim panel and changer, the control cable can be connected





13

... and placed the cable under the carpet



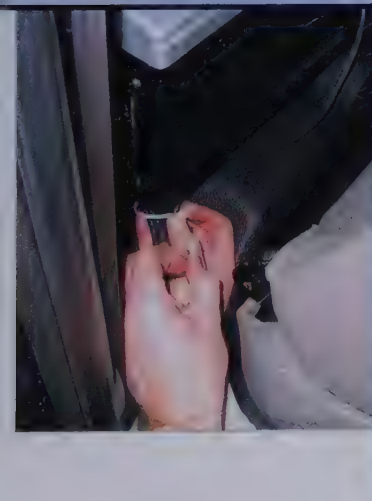
14

We're going to mount the changer to the trim panel behind the seat



15

After removing the panel we marked where the mounting brackets needed to be placed ...



20

Use wire ties to wrap up any excess control cable.



21

Route the control unit and cable from the FM modulator to a convenient location. With the installation complete, follow the manufacturer's instructions, tuning the head unit to the proper FM station, then test the player.



22

Our final task was to mount the controller; we accomplished this by using Velcro and attached it to the center console

07

Satellite Radio

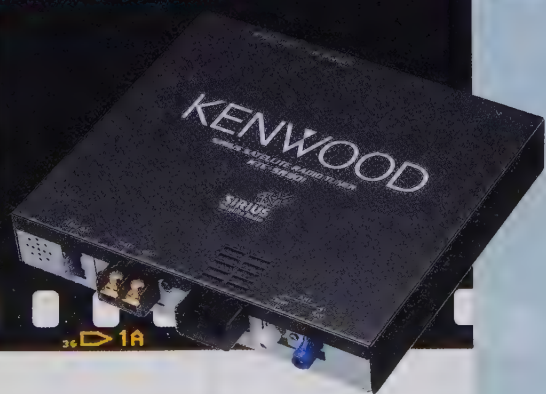


Tired of all those boring radio commercials? Tired of static when you're losing a radio station signal? Or the radio station's playing the same songs over and over? Now there's a solution -

Satellite Radio

Satellite radio provides commercial-free programming with a broadcasting range that is nationwide. With up to 100 different channels of digital programming to choose from, including music, sports, news and a wide variety of non-musical entertainment, satellite radio provides the subscriber with an alternative to conventional radio and its accompanying annoyances.

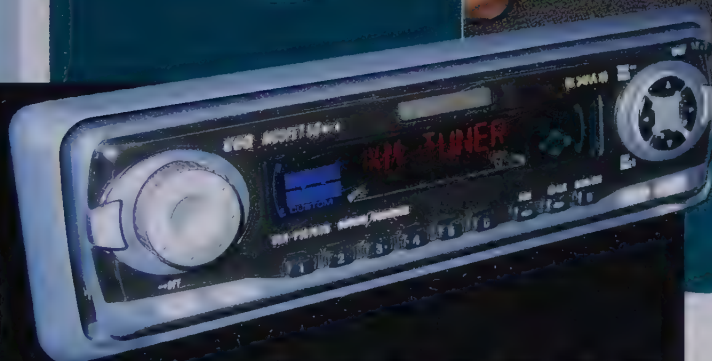
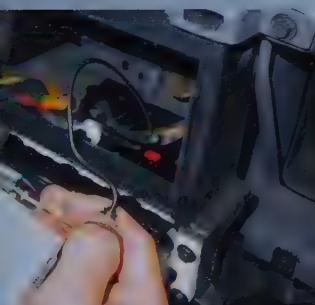
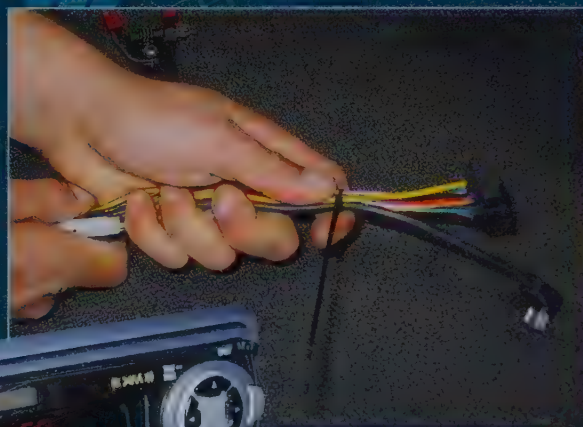
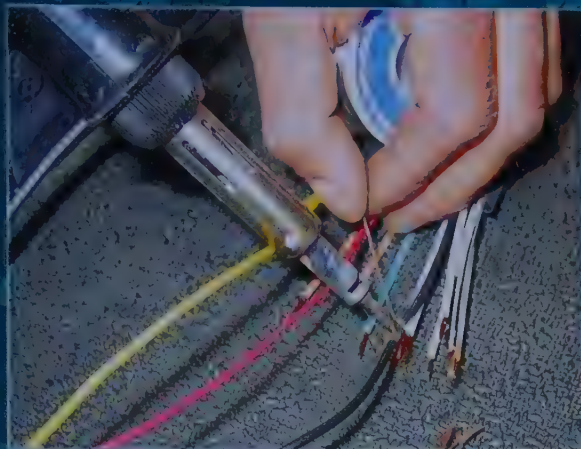
Satellite radio can be added to your existing radio two ways - by an FM modulated control, or by the use of a plug-and-play control unit and tuner (as long as your current radio has an auxiliary input). The tuner can be mounted in the trunk, glove box or under a front seat. Avoid mounting the tuner where moisture or extreme heat may arise, as this could damage the unit. Purchasing a satellite-radio-ready receiver and same-brand-satellite radio tuner with antenna can cost around \$350. Alternatively, an RF modulated system might only set you back \$250. For this installation we chose to replace the existing

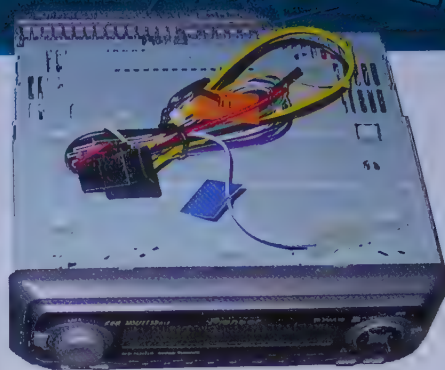


factory radio with a satellite-ready radio and matched it with a same-brand satellite tuner.

At the time of writing there were two major players on the satellite radio scene: XM Satellite Radio (www.xmradio.com) and Sirius Satellite Radio (www.siriusradio.com). They both work in a similar fashion; radio waves are bounced off a network of satellites orbiting the planet and picked-up by the satellite radio receiver in your vehicle. An initial start-up fee is required, plus a monthly subscription fee of approximately \$9.99 to \$12.95 a month.

There are any number of ways to wire up your tuner - some better than others. For a trouble-free connection and professional looking result, solder the bare wire ends, use a heat gun and shrink tubing to insulate the soldered sections, then tie the wires into neat bundles with plastic wire ties. For more information on soldering and other wiring techniques, see Chapter 1.

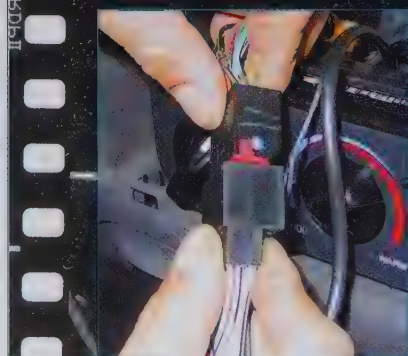
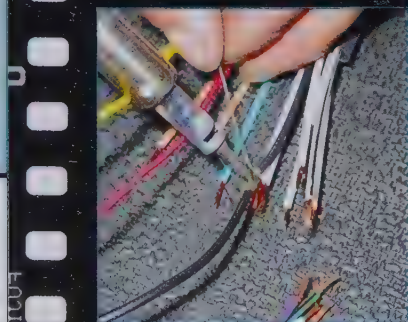




Satellite Radio

XM Satellite Radio

installing the head unit

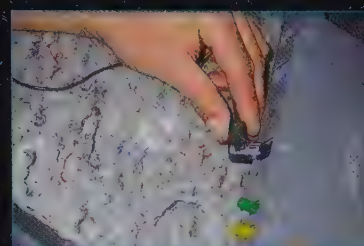


01

We started our install removing the factory stereo head using DIN removal keys, and slid the player straight out



Warning: If you're working on an airbag-equipped vehicle, see the Warning on page 9 before starting this procedure.





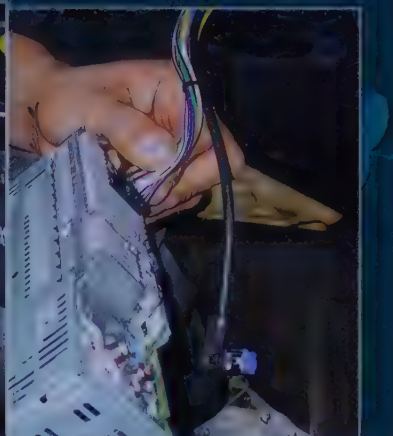
02

With the player hanging out, it was easy to disconnect the harness and antenna



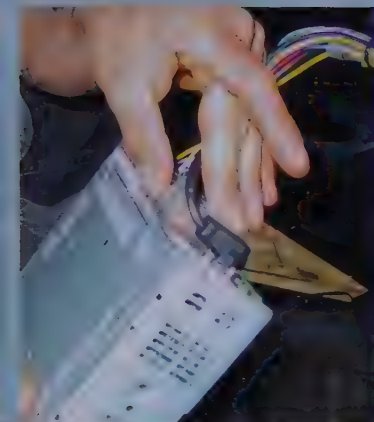
03

Connect the OEM harness to the vehicle's factory harness and run the bus cable and XM tuner power cable to where the XM tuner will be mounted



04

Connect the radio's harness ...



05

... the IP-Bus cable and the radio's antenna



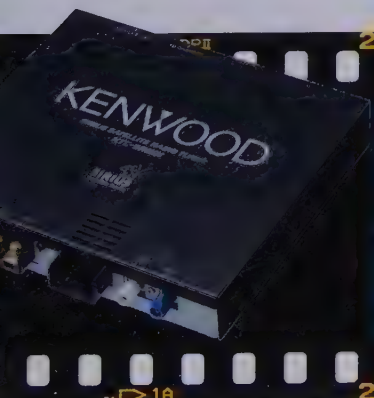
06

Carefully slide the radio into the mounting sleeve ...



07

... until it snaps into place



Available channels

Current as of the printing of this book. For more information go to the websites
www.siriusradio.com or www.xmradio.com

Sirius

Pop streams

Top 40 hits
Adult Contemporary
Love songs
Easy listening
Best of the '50s
Best of the '60s
Best of the '70s
Best of the '80s
Christian Hits

Rock streams

Classic Rock
Deeper Classic Rock
Jam Bands
Adult Album Alternative
Modern Rock
Alternative Rock
Classic Alternative
Stadium Rock
Eclectic Rock
Mellow Rock
Underground/Indie
Metal
Blues

Country streams

Today's Country Hits
Country Mix
Classic Country
Alternative Country
Bluegrass

Hip-Hop streams

Today's Rap
Int'l Rap - Spoken word
Freestyle
Old Skool Rap
Rap Hits

R&B streams

Urban Contemporary
R&B Hits
Soul Ballads
Classical Soul

Dance streams

House Music
Non Stop Club Mix
Mainstream Dance
Electronica
Dance Hits
Dance Hits
Disco

Jazz/Standards streams

Contemporary Jazz
Smooth Jazz
Classic Jazz
Swing
Standards
Show Music

Classical streams

Symphonic

Chamber Works
Classical Voices

Variety streams

Latin Pop Mix
Mexicana
Reggae
Folk
Gospel
Kids

New Age
World Music
Live-Features

News streams

CNBC
Bloomberg Radio
ABC News and Talk
CNN Headline News
FOX News Channel
NPR Now
NPR Talk
PRI's Public Radio Channel
The Weather Channel Natl
The Weather Channel East
The Weather Channel Ctrl
The Weather Channel West

C-SPAN Radio
BBC World Service News
World Radio Network
BBC Mundo

Sports streams

ESPN Radio
ESPNEWS
Sports Byline USA
Speed Channel Radio
Sports: Play-by-Play
Sports: Play-by-Play
Sports: Play-by-Play
OLN Adventure Radio
Radio Deportivo

Entertainment streams

Radio Disney
Sirius Trucking Network
WSM Entertainment
Radio Classics
Court TV, Plus
Sirius Entertainment
E! Entertainment Radio
A&E Satellite Radio
Discovery Channel Radio
La Red Hispana
Radio Amigo
Radio Mujer
The Word Network
WISDOM Radio
Sirius Right
Sirius Left
Sirius Talk
Sirius Comedy
Preview Stream

XM

Decades

Big Bands & Hits of the 40's
Early Rock 'n Roll of the 50's
The Authentic 60's Sound
Best of the 70's
The Awesome 80's
The 90's Live on 9

Country

Classic Country
Round the Clock Country Hits
Progressive Country
Old Time Country
From Bluegrass to Newgrass
A Celebration of Folk Music

Hits

Interactive Top-20 Countdown
Top-40 Hits from Los Angeles
Pop Music Mix
All Love Songs 24/7
Beautiful Music
MTV Radio
VH1 Radio
Escape Into the Movies
Broadway & Showtunes
From the World's Pop Charts
Anything Can Happen . . .
really, ANYTHING!

Christian

Christian Music that Rocks
Adult Contemporary Christian

Rock

Deep Album Cuts
Stadium Rock and Hairbands
Industrial Strength Metal
New Music . . . Now
Classic Alternative
Mellow Alternative
Classic Album Cuts
Alternative Hits
Hard Alternative
Singers and Songwriters
Progressive Rock & Fusion
Unsigned Bands Only!

Urban

The Greatest Soul Music of All Time
Neo Soul
Urban Adult
Glorious Gospel
Old School R&B
Hip Hop from Day One
Uncensored Hip Hop
Urban Top 40

Jazz & Blues

Traditional Jazz
Easy Jazz
Contemporary Electric Jazz
Sinatra & Friends
Capital of the Blues
Latin Jazz
The Lounge Lifestyle Lives On

Dance

Underground Dance

Club Hits
Electronica
Where Disco Doesn't Suck

Latin

Regional Mexican
Spanish Pop Hits
Rock en Español
Tejano
Music from the Caribbean

World

World Music
The Most Mighty, Wicked,
Dangerous Reggae Ever
The Sound of Africa
Cerebral New Age
Eclectic Mix from Celtic to
the Blues

Classical

The Greatest Music of the Last
1,000 Years
The Magic of the Human Voice
Classical's Greatest Hits

Kids

Radio Disney
The Next Generation of Radio
. . . For the Next Generation

News

Fox News
CNN
CNN Headline News
ABC News and Talk
The Weather Channel
CNBC
Bloomberg News
CNET Radio
BBC World Service
C-SPAN Radio
CNN en Español

Sports

ESPN Radio
ESPNEWS
Fox Sports Radio
The Sporting News
NASCAR Radio

Comedy

Everything Funny
Family Laughs and Fun
24-hour Crazy Morning Shows

Talk & Variety

Discovery Radio
E! Entertainment Radio
Audio Books and Radio Dramas
The Golden Age of Radio
Experts Talk
America's Hottest and Most
Controversial Talk Stars
Concerts and Interviews
No Compromise African
American Talk
Christian Talk
America's First Trucker Channel

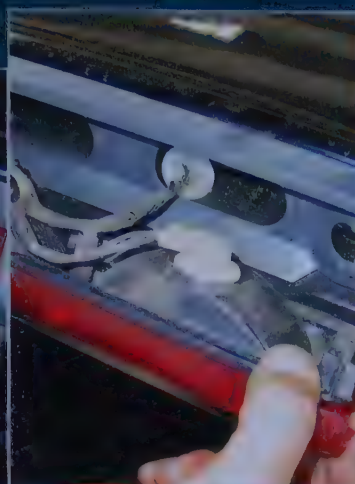
Premium

Playboy Radio

Satellite radio receivers require a separate antenna to receive the satellite's signal.



01 We decided to mount the magnetic antenna onto the roof and run the antenna wire through the high-mounted brake light



02 After removing the brake light ...



03 ... we fed the antenna wire through where the brake light harness enters the cab. Be sure the harness plug has a tight seal or when it rains, water will enter the passenger compartment

Mounting the antenna

There are four basic types of antennas available:

Adhesive (glass-mount)

- Adhesive secures the antenna to the outside glass and the wire is attached inside the window by a coupler.

Adhesive (roof mount)

- Adhesive permanently secures the antenna to the vehicle surface, the wires must then be routed carefully into the vehicle.

Magnetic (roof mount)

- Similar to the adhesive type, but this type can be easily removed from the vehicle.

Mast type - These types of antennas are installed primarily on large trucks.

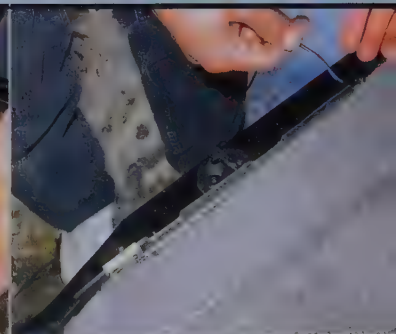
04 Inside the passenger compartment we carefully ran the antenna wire along the inside of the headliner and down along the inside quarter panel trim



05 To hide the antenna wire along the floor, remove the door sill plate ...



06 ... and run the wire under the carpet

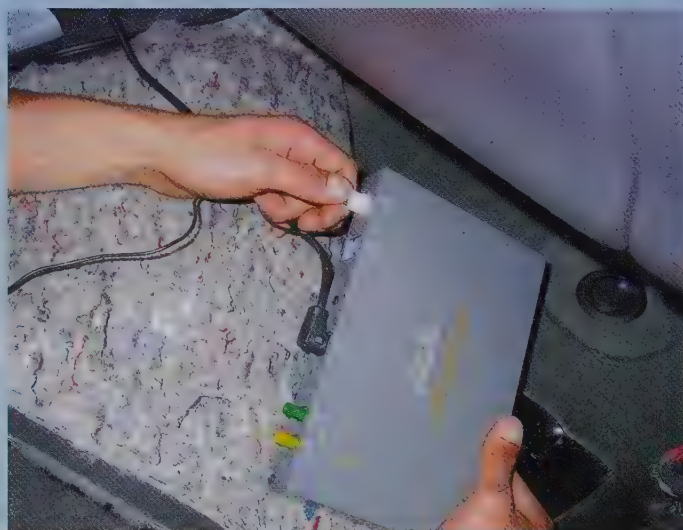




Mounting the tuner

01

The XM tuner is being mounted under the passenger's side carpet; after pulling back the carpet we follow the manufacturer's instructions and connect the IP-Bus cable . . .



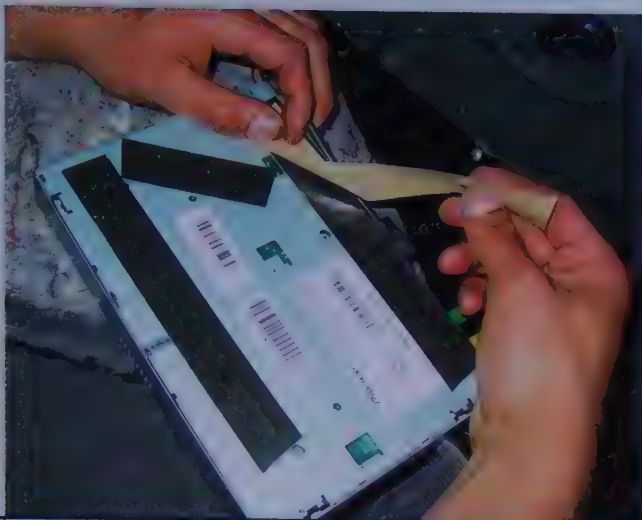
02

. . . tuner power wire . . .



03

. . . and the antenna



04

Now it's time to mount the tuner unit. With this vehicle, we decided to mount the tuner using double-sided tape to save the floorpan from screw holes



05

With the installation complete, follow the manufacturer's instructions for tuning the radio

FAQs

Satellite Radio

When installing Satellite radio, can I use my existing radio antenna?

Digital satellite radio receivers require a separately mounted antenna to receive the signals.

How many companies broadcast satellite radio?

Currently at the time of this writing there are only two, SIRIUS and XM Satellite Radio.

Can I receive both services with a single tuner?

No, the hardware to receive the signals is not interchangeable. To be compatible, you'll need separate tuners for the different service providers.

Does satellite radio have a subscription fee?

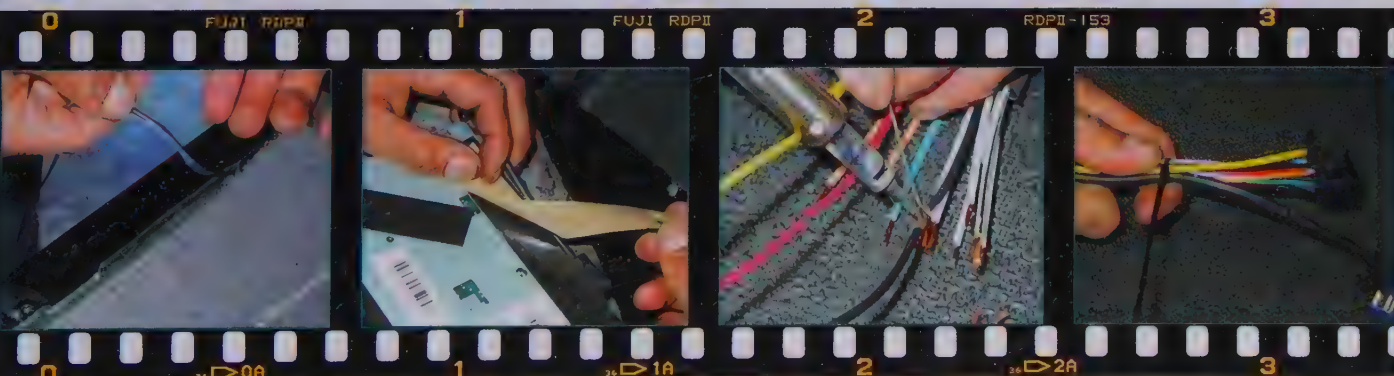
Yes both suppliers charge a minimal monthly fee.

Can I still receive local radio station signals?

Satellite radio is broadcast on an entirely different band than AM or FM radio, so you can still play the local radio stations.

How do I activate my service?

Both current services offer a call-in subscription or you can go to their web site.



08

Mobile Video



Mobile Video

It's not just about cranking up the jams. Mobile video systems are available so you can watch DVDs, hook up TV, video tape players or even video game consoles. We spend a lot of time in our rides. So why not take your driving machine to the next level?

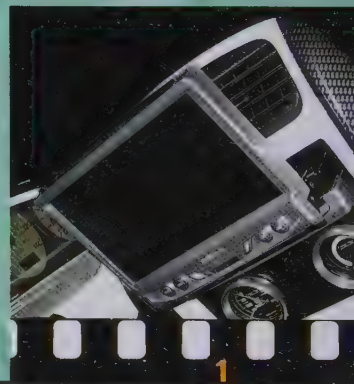
What was once an extravagance that would only be found in a limo, many mobile video system components are available to entertain passengers or impress your friends when just hanging out.

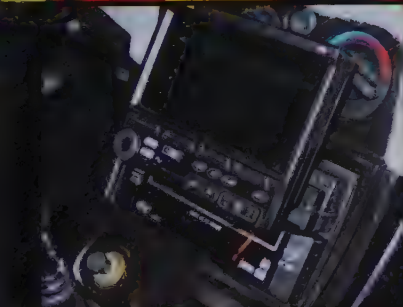
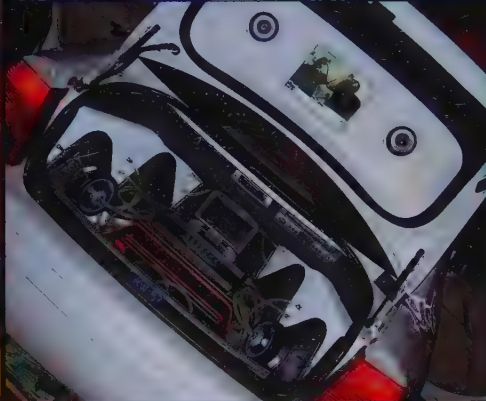
The simplest mobile video systems are portable, self-contained units which can be strapped into place between the two front seats. There are other systems similar to these, but they're built into the center console and aren't easily removed like the portable type.

If this type of video system is not what you had in mind, a component system is your alternative. Basically a component system consists of a source, monitor and audio. With a component system, you have the flexibility to add monitors or different source units and create a custom, almost "theater-like" environment.

Show Only!

In some pictured show cars, airbags have been replaced with video screens. In others, screens have been mounted in the driver's view. Both of these installations are illegal and dangerous on street cars!





2

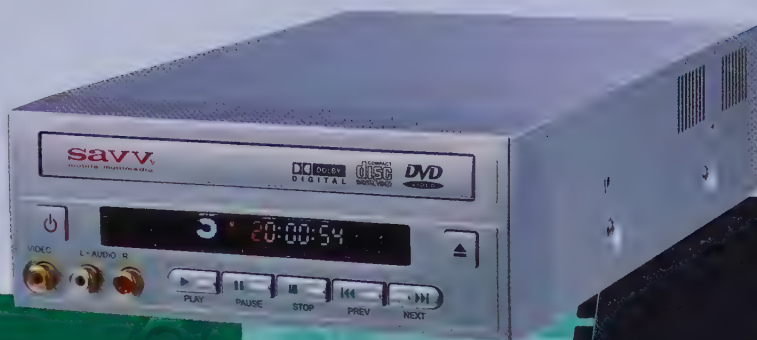
36 2A

3

36 3A

4

36



Left - DVD -player



Below - TV tuner



VHS player

Source

All component systems begin at the source unit, which could take the form of a remotely mounted VHS tape deck (old skool) or DVD player, DVD changer, in-dash DVD player, in-dash multimedia player, an overhead flip-down screen with an integral DVD player, a game console, a TV tuner or a combination of these.

This Kenwood in-dash DVD player features a motorized monitor that retracts when not in use. It is also an AM/FM radio receiver and TV tuner, plays CDs and MP3 format CDs, and is Sirius satellite radio ready (Kenwood Corporation)





Overhead monitor



Headrest monitor

Monitors

Monitor types include the in-dash motorized screen, sunshade monitors, headrest monitors, flip-down overhead console monitors, center console monitors, and monitors that can be mounted on a pedestal or bracket just about anywhere in the vehicle where there's enough room. Just keep in mind that no screen visible to the driver can be operational when the vehicle is in motion.



Switcher

Sound

An option that's available with some systems are infrared headphones that allow passengers to listen to the movie or game audio track without the hassle of cords that could get in the way. The infrared signal on these systems is broadcast from transmitters embedded in the monitor housings or from a remote transmitter, usually mounted on the headliner or at the rear of the overhead console where the line-of-sight between the transmitter and headphone will be uninterrupted.

Audio can also be piped through the vehicle's existing speakers. If you've upgraded your audio system with a surround sound system, your passengers will be able to enjoy a near-theatre experience. The source unit can either be hard-wired into the system or an FM modulator can be used, which really simplifies the installation process.





Some inverters can plug into the cigarette lighter, but if you frequently use it for other items, consider hard-wiring it into the vehicle. Follow the manufacturer's instructions for wiring it. This inverter was installed under the back seat for connecting a video game console.

How can I connect my PlayStation 2 console?

Video game consoles can be integrated into the system by the use of a signal distribution box and a power inverter that converts 12 volts DC into 110 volts AC. And, with the use of a switchbox or video input jacks a video game console can be connected in no time at all.



How much is it going to cost?

Trying to stay on the cutting edge of mobile entertainment technology can put a dent in your wallet. Here's a few examples of costs:

- An in-dash 7-inch monitor with touch-screen control, DVD/CD/MP3 player can set you back \$2000 or so.
- External DVD players can cost around \$150 to \$200.
- A stand-alone 5" monitor runs around \$200; a 7-inch widescreen monitor about \$450.
- A 7-inch overhead monitor will lighten your purse by about \$700, and a 7-inch motorized overhead monitor by about \$900
- A 7-inch vehicle-specific headrest monitor will cost around \$550 or more, depending on the type of upholstery you have.





The “what’s legal and what’s not” part . . .

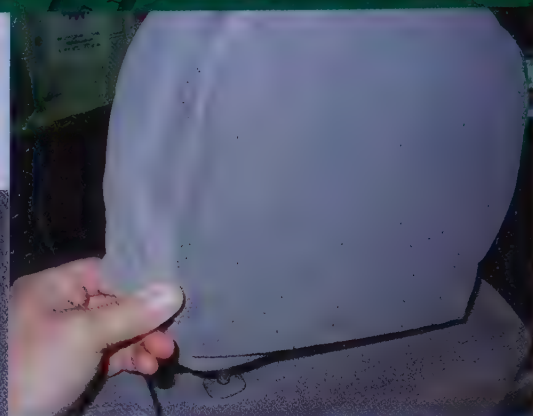
Considering the issues of driver distraction involved with video monitors:
The following was taken directly from a statement by the Consumer Electronics Association:

- An LCD panel and/or video monitor may be installed in a motor vehicle and visible to the driver if the LCD panel or video monitor is used for vehicle information, system control, rear or side observation or navigation.
- If the LCD panel or video monitor is used for television reception, video or DVD play, the LCD or video monitor must be installed so that these features will only function when the vehicle is in “park” or when the vehicle’s parking brake is applied.
- An LCD panel or video monitor used for television reception, video or DVD play that operates when the vehicle is in gear or when the parking brake is not applied must be installed to the rear of the driver’s seat where it will not be visible, directly or indirectly, to the operator of the motor vehicle.

CEA’s Mobile Electronics Division recommends these practices.

So before you go nuts and drop some serious coin installing video monitors everywhere in your ride, it might be wise to check with your local authorities, stereo installer or for more information, go to www.ce.org/mobile or call CEA at (703) 907-7600.





Purchasing an optional headrest cover is not only a good security measure, but it can also protect your monitor from dirt or scratches when not in use

Mobile video

Mobile video system installation

Vehicle-specific headrests

So you've decided to install headrest monitors, but cutting into the factory headrests, scooping out some foam, installing a frame then snapping the monitor into the frame is not what you had in mind. The easy option is installing vehicle-specific headrests like these from savv®. The installation requires no disfiguring headrest modification - the vehicle-specific headrests are designed to replace the factory headrests and after a few easy steps a monitor can be installed.



01

After removing the factory headrest, we started by unsnapping the fabric at the bottom of the seat back





02

The cable from the headrest's hollow post was fed down through the seat, then we installed the headrest



03

We connected the monitor's 8-pin DIN plug into the headrest's 8-pin DIN plug



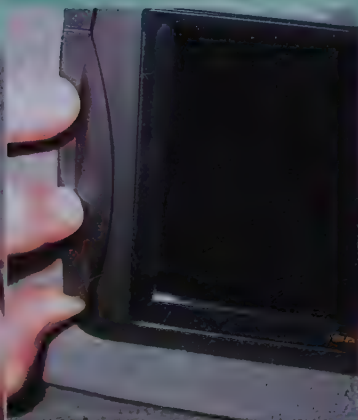
04

The remainder of the cable was fed into the headrest



05

Then we placed the monitor into its mounting frame ...



06

... and attached the clips to secure the monitor



07

At the bottom of the seat, the monitor's DIN cable is attached to the external A/V power cable (this is the DIN-to-RCA cable which will connect to the A/V selector box). Be sure to use cable ties to prevent the wiring from interfering with the moving parts of the seat





Headrest monitor installation

If no vehicle-specific headrests with monitors are available for your vehicle, or for some reason you want to retain your headrests, you can modify them to accept video monitors. If you take your time and work carefully you will wind up with a very clean-looking installation, and save a little cash as well. The only real drawback to choosing this route is that the cable to the monitor will be slightly exposed if the headrest is raised.



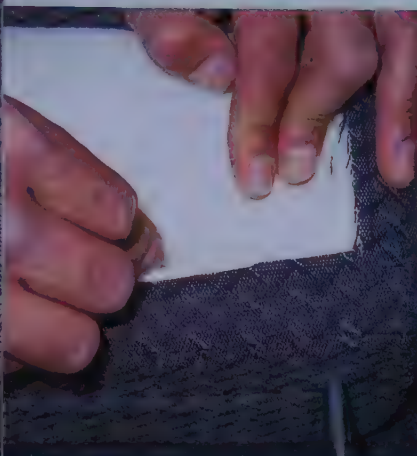
08

Mark the fabric to be cut on the headrest, using the inside of the housing as a template. Be sure to center the housing and make sure it's straight!



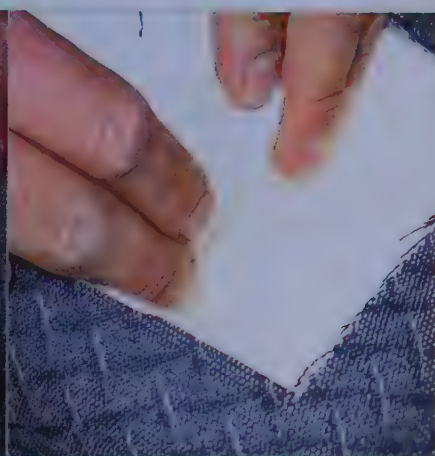
09

Carefully cut the fabric, inboard of the marks just made, using a sharp razor blade



10

Cut and remove the foam padding only to the depth required to allow the housing to fit snugly, and flush with the back of the headrest



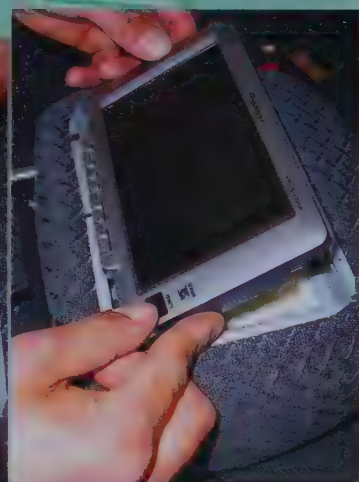
11

Since headrest designs differ between manufacturers, you'll have to figure out a way to mount the housing. With this particular headrest we used a number of zip ties to hold the housing to the headrest support posts



12

The monitor's A/V wire should be fed through the housing then exit at the bottom of the headrest next to one of the support posts



13

Connect the A/V wire, then mount the monitor into the housing following the manufacturer's instructions



Overhead monitor installation

Too many kids? Not enough headrests? Install an overhead monitor and keep everyone happy!

Several overhead monitors are supplied with generic housings like this one from savv®. The kit comes with everything needed to install an overhead monitor that looks almost factory.



14

Installing an overhead monitor requires dropping part of the vehicle's headliner

15

This overhead monitor is replacing the vehicle's dome light



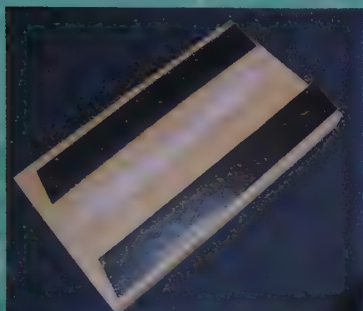
16

A pattern is drawn on the headliner and a hole cut through it for the monitor's mounting bracket and wiring



17

The mounting bracket will be secured to the roof's structural support . . .



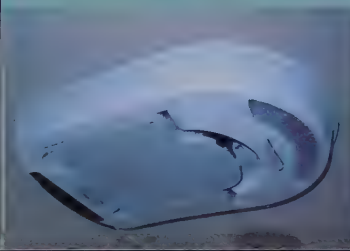
18

. . . and a board that's been attached to the roof with silicone and double-stick tape



19

The monitor housing is then attached to the mounting bracket



20

Any gaps between the monitor housing and the headliner are taken up by the application of the supplied gasket



21

Some interior panels will require disassembly for the routing of the video cables

???

FAQs

Mobile video

If I want to install headrest monitors, do I need to cut up my headrests?

Vehicle specific headrests are available for most vehicles, making it unnecessary to cut the factory headrests.

How many speakers will I need for multi-channel surround sound?

Four side speakers, two in front and two in the rear. Also you'll need a center speaker and a subwoofer.

How much information can be stored on a DVD disc?

A single-sided DVD can hold up to 4.7GB.

If I purchase a DVD player, will the player also play my CDs?

Most DVD players can play back audio CD's as well.

I have two sets of headphones for my video system but they are always getting tangled or tripped over. What can I do?

Wireless headphone systems are available that transmit the audio signal using either infrared or radio frequency transmitters.

Is it possible to integrate my video system's audio with my vehicle's factory audio system?

Yes, the easiest solution would be to use an FM modulator but if you want to upgrade, replace the factory head unit with a DVD player or multimedia station.

What type of video system is the easiest to install?

The portable, self-contained units are probably the easiest for the do-it-yourselfers. Installing them is usually a matter of connecting the power wire to the 12-volt power outlet (cigarette lighter).

What size monitors?

For now, monitors for a vehicle range in size from 5 to 20 inches.



22

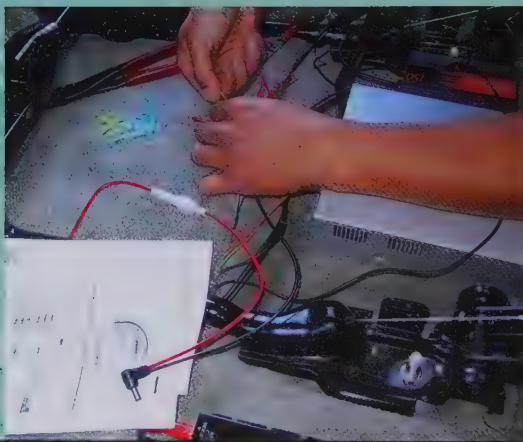
A stand-alone DVD player can be mounted in a convenient location like this under the middle seat



23

Using the supplied mounting brackets, the player can be secured to the floor in no time at all

DVD player installation



24

Follow the manufacturer's instructions for connecting the power wires



25

A DVD player with accessory inputs, makes it possible to connect a video game console or an alternative video source



26 If the DVD player has a remote sensor, mounting it somewhere on the dash is a smart choice



27 This AV selector is designed to independently control the video source for up to 3 monitors



28 Each remote should be mounted somewhere close to the monitor it controls. The hard-wired remotes control the video source input device to be displayed on the corresponding monitor . . .

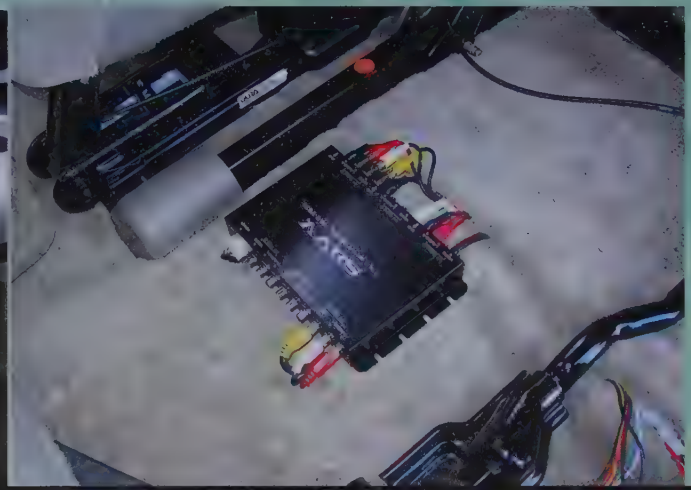
3 input - 3 output video selector installation



29 . . . so one passenger might be playing video games . . .



30 . . . and another watching a movie on a different screen



31 The AV selector has a lot of wires connected to it, so mounting it away from foot traffic is definitely a good idea

09

Navigation systems

Navigation systems

A navigation system is an electronic map, sitting right there in your dashboard. Imagine, no more fumbling with a map spread across the seat as you drive, and no more stopping to ask directions!



Types of navigation systems

Presently, there are four basic navigation systems in the marketplace:

- 1 Voice activated.
- 2 Telepath™.
- 3 GPS (Global Positioning Satellite) locators.
- 4 Advanced Route Guidance systems.



Blaupunkt's TravelPilot DX-N stand-alone vehicle navigation and voice route guidance system



Voice activated

The first voice activated navigation systems reached the market in the mid-'90s. A voice activated system operates via a specially designed CD-ROM or DVD that contains a database of roads, highways, landmarks and thousands of points of interest (POI). Each street name, highway, city and POI has been recorded on the CD-ROM or DVD, which is loaded into a specially designed changer or player. The user can activate the system via microphone mounted in the car by saying a specific word like, "Navigator." The voice activated system then asks a series of questions like "Where are you starting from?" or "Where do you want to go?" The system then gives you verbal commands, telling you where and when to turn, guiding you effortlessly to your destination.

Telepath™

This system was developed by Delco Electronics (a division of General Motors). Telepath uses the Global Positioning Satellite (GPS) signal to calculate its current location. It also employs a dead-reckoning system that uses a compass and the vehicle speed sensor to calculate the position of the vehicle just in case GPS signals aren't detectable.

The user inputs the destination via a small LCD type display. Destinations can be entered via address, intersection, or landmark (such as "ATM" or "GAS"). The information database is contained on a flash-memory card. The system directs the driver with an arrow and shows the distance to the destination.

Blaupunkt's RNS 149
TravelPilot car stereo
CD receiver



GPS locators

GPS locator systems utilize a "moving map" on a video screen in the vehicle to direct the driver. This system utilizes a digitized map of a specific area with "hidden" longitude and latitude coordinates. The system incorporates a GPS receiver. The GPS receiver must receive at least three GPS satellite signals to determine the correct longitude and latitude coordinates. The GPS information is then compared to the digitized map data. When the current location is found on the map, that image of the map is displayed on the screen.

These systems rely only on the GPS signal to find the location of the vehicle. This system *does not* take into account vehicle speed or direction, therefore, turn-by-turn guidance is sometimes not completely accurate. This system can show the driver the destination on the digitized map, but it's up to the driver to figure out how to get from Point A to Point B. Many of these types of systems are also portable, enabling the driver to remove the unit and proceed on foot, if necessary.

Advanced route guidance systems

This type of system utilizes three different input sensors to determine the present location and track the progress of the vehicle:

GPS antenna/receiver - uses GPS satellites to determine the current position of the vehicle.

Gyro sensor - determines the direction in which the vehicle turns.

Vehicle Speed Sensor (VSS) - determines how far and how fast the vehicle has traveled.

Thanks to the gyro sensor and speed sensor, these systems more accurately display the vehicle's position and track the vehicle's progress - even when driving in areas where the GPS signal may be blocked.

Kenwood's KNA-DV2100
DVD Mobile Navigation
System



Here are the basic elements of an advanced route guidance navigation system:

Main navigation ECU - the "brains" of the navigation system. Includes a built-in gyroscopic sensor, speed pulse sensor, Global Positioning Satellite receiver, and DVD or CD-ROM drive. It processes:

- The incoming data from the vehicle's speed sensor.
- The speed of the vehicle.
- The direction coming from the gyro sensor.

GPS antenna - receives incoming satellite signals.

- The antenna has a small footprint and some have a magnetic base.
- It's designed to be mounted with inside applications as well as outside of the vehicle.
- The antenna must have a clear view to the sky to receive satellite information.
- GPS reception can be slightly reduced when the antenna is mounted inside the vehicle.

CD-ROMs or DVDs - contain the maps for each locale (which can be updated periodically).

- Some companies rely on universal mapping software.
- Other companies provide customized DVD or CD-ROM discs.
- DVD has the ability to store entire countries.
- On some systems, when you install the system, you have to install the correct CD for your geographic area. Other systems allow you to swap CDs when you change geographic areas.

Video monitor - displays directions.

- Some monitors include a built-in speaker.
- Some monitors can be used to interface and control the audio system.
- Most monitors allow the driver to "zoom in" and "zoom out" to show more or less detail on the map.

Remote control - many systems include a wireless remote control to help operate the navigation system.

What's it going to cost me?

Knowing exactly where you are can put a serious dent in your pocket book! So shop around and decide what system is for you.

- A hand held GPS Unit can range from \$150 to \$1000 depending on the features.
- In-dash units can set you back \$1000, and other higher end multimedia stations can cost around \$2000.

Basics of installation

There are countless ways to install a navigation system. Accordingly, we do not have the luxury of being able to cover each application. Therefore, we will cover the basics. Following are the basic guidelines you should follow when installing an Advanced Route Guidance navigation system.

Mounting the ECU

On some systems, the main navigation computer is designed to be mounted in the trunk; on others, it can be mounted in the trunk or the glove box (depending on the available space). It must be mounted in a location free of moisture or extreme heat, and it must be mounted horizontal (less than 5°), the gyro sensor mounted inside the ECU will not work properly when the unit is mounted on its side.

Mounting the antenna

The GPS antenna needs to be mounted in a location that is the most "visible" to the GPS satellites. Therefore, you need to carefully plan the location. When determining the mounting location, follow these guidelines:

- Do not mount under any metal surface.
- Some window tinting material has a high metal content (titanium), which can reduce the GPS antenna's reception.
- Some vehicles - like the Oldsmobile Aurora - incorporate special heat-resistant glass that will cause GPS reception problems. For these situations, it's best to install the GPS antenna on the roof or the trunk lid.
- Mounting the antenna under dense plastics or cardboard may inhibit reception.
- The GPS antenna can receive the needed signals when mounted inside the vehicle, but some precautions must be taken to ensure proper performance. Mount the antenna in a location in the vehicle that allows the best "line-of-sight" performance. Locations such as the rear package tray or front dash work the best.
- Secure the antenna with double-sided tape or silicone (this helps prevent the magnetic base from moving and scratching the paint).
- Carefully route the antenna cable and connect it to the ECU.
- The antenna is matched to its cable length - do not shorten or extend it.
- Avoid making sharp bends in the cable.
- Wind excess cable into large loops and secure with cable ties.

Mounting the monitor

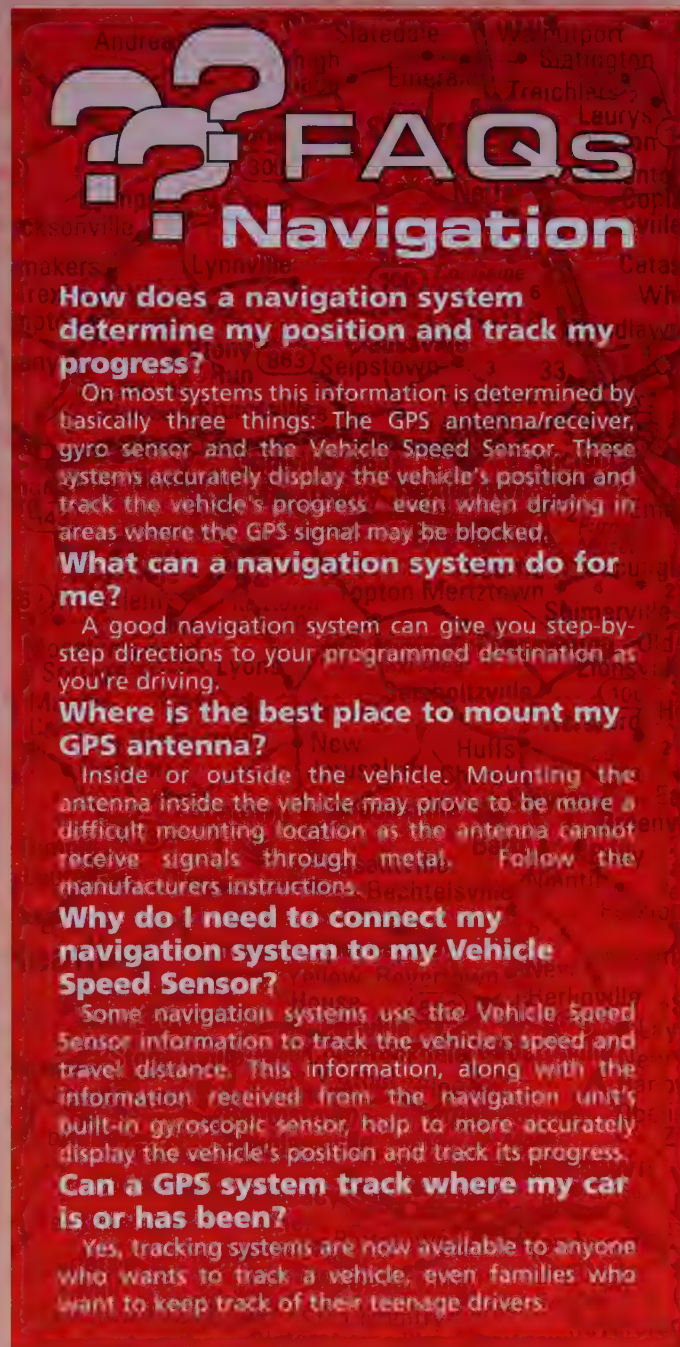
Like most installations, you have to plan out where you want to install the monitor. It needs to be convenient, yet unobtrusive - you don't want it blocking any of the vital controls. Try to mount the monitor so it can be seen without too much distraction. If the monitor will be mounted low, angle it up for best performance. Don't mount the monitor where it could be struck by an airbag in the event of an accident. Also, most monitors come with a fixed length of cable that cannot be extended. Keep this in mind when routing the monitor cable to the ECU.

Once the installation is complete, adjust the monitor's brightness level for best performance. Most monitors have a

separate brightness adjustment for day and night viewing (when you turn on the parking lights, the display dims).

Wiring

Wiring most navigation systems is about as simple as wiring a CD changer or a head unit. Typically, there are only six wires to connect on the main harness. If there are any remaining wires, they are usually used to connect the navigation system to the audio system.



FAQs Navigation

How does a navigation system determine my position and track my progress?

On most systems this information is determined by basically three things: The GPS antenna/receiver, gyro sensor and the Vehicle Speed Sensor. These systems accurately display the vehicle's position and track the vehicle's progress - even when driving in areas where the GPS signal may be blocked.

What can a navigation system do for me?

A good navigation system can give you step-by-step directions to your programmed destination as you're driving.

Where is the best place to mount my GPS antenna?

Inside or outside the vehicle. Mounting the antenna inside the vehicle may prove to be more a difficult mounting location as the antenna cannot receive signals through metal. Follow the manufacturers instructions.

Why do I need to connect my navigation system to my Vehicle Speed Sensor?

Some navigation systems use the Vehicle Speed Sensor information to track the vehicle's speed and travel distance. This information, along with the information received from the navigation unit's built-in gyroscopic sensor, help to more accurately display the vehicle's position and track its progress.

Can a GPS system track where my car is or has been?

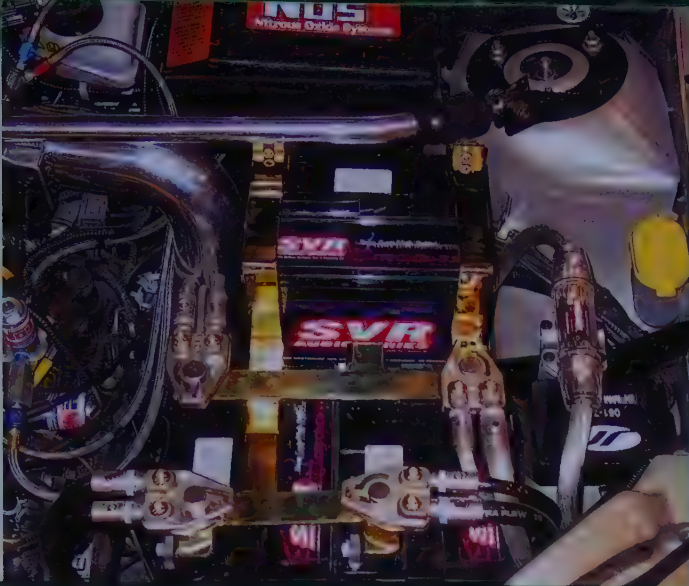
Yes, tracking systems are now available to anyone who wants to track a vehicle, even families who want to keep track of their teenage drivers.



Accessories and necessities

Before you can install head units, amplifiers, speakers or any other mobile electronic components, you still need to select the right wiring, connectors, fuses, circuit breakers, inverters (if necessary) and sound dampening materials. Without the right stuff, your system either won't work at all or it'll work, but won't sound as well as it could or last as long as it should. So study the sections in this chapter before you run out and buy stuff that turns out to be junk, or before you get so anxious to install your gear that you just start twisting and taping wires together. *Remember: Take your time and do it right!*

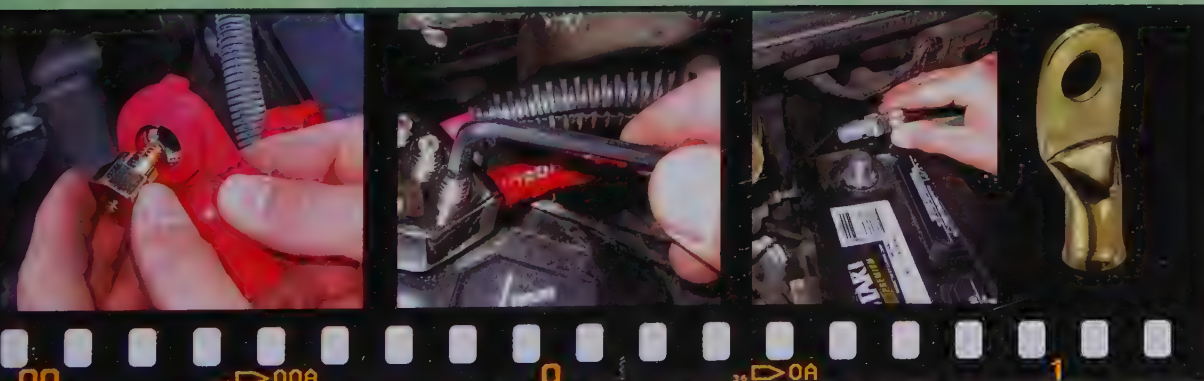




Battery connections: it all begins, and ends, here

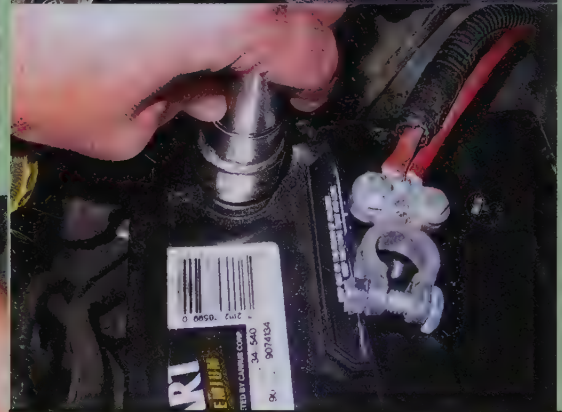
At the risk of overstating the obvious: A sound system is useless without the battery because that's where the power comes from. No one disputes this, nor does anyone deny that power-hungry amplifiers will suck all the current they can get from the battery. Yet the system's power and ground connections at the battery are often an afterthought, thrown together at the eleventh hour "just to get it running." Sure, you *intend* to get back to it . . . later, maybe (and you know what they say about the road to hell . . .). But, guess what? More often than not, later never arrives. Meanwhile, those funky battery connections that you threw together with some connectors you had laying around your garage slowly begin to get dirty and corroded. And the quality, or at least the peak power, of your sound system begins a long downhill slide.

Make no mistake. Skimp on the quality of the power and ground cables' battery terminal connectors and you'll end up with a six-month instead of a ten-year system. Poorly connected power wires at the battery can wreak havoc on an audio system. So keep your connections neat by replacing the battery cable clamps with aftermarket units that provide extra connections for cables or ring terminals.

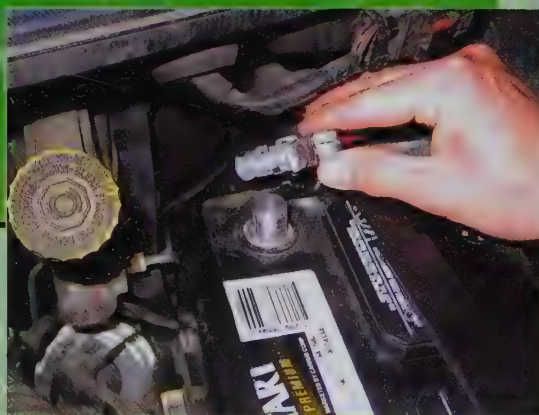


Installing aftermarket battery cable connections

Start by disconnecting the cable from the negative battery terminal. *Always* disconnect the negative cable first! If you start by disconnecting the positive cable first, you run the risk of creating large and powerful sparks if the tool you are using to loosen the cable clamp comes into contact with a ground point on the vehicle (such as the body or other metal component). Not only can this burn you, it could also cause the battery to explode!



Clean the battery terminal posts with a battery terminal cleaning tool (available at most auto parts stores)

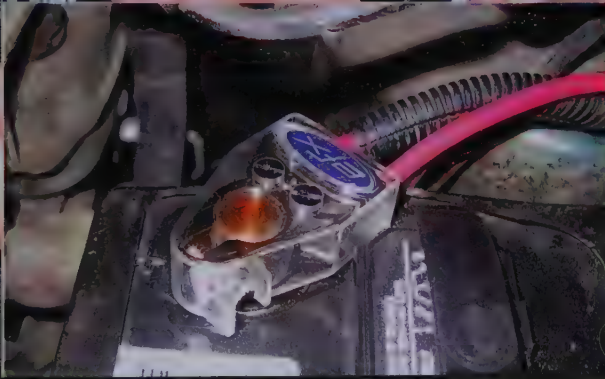
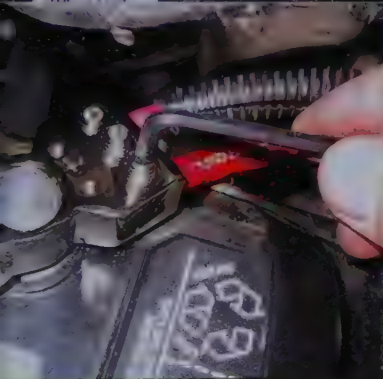


02 After you have disconnected the cable from the negative terminal, disconnect the cable from the positive terminal. Because they've been attached to the terminals for a long time, battery cables have some "memory" in them, which means they want to remain in the same position they're usually in, even when you disconnect them. So make sure that you not only set both cables aside but that you secure them in such a way so that they don't flop back into their connected positions and touch the battery terminals!

On some vehicles, you might need to cut off the battery cable clamps. If you do, make sure that you will have enough cable left to reach the terminal post. You don't want either battery cable so short that it's stretched tight when connected to its terminal

Strip off enough insulation from the battery cable so that when installed in the new terminal clamp, the part of the cable that's inside the terminal will be in full contact with the terminal. Make sure that the gauge of the cable matches the gauge of the hole in the clamp, then insert the exposed end of the cable into the terminal clamp and tighten it securely

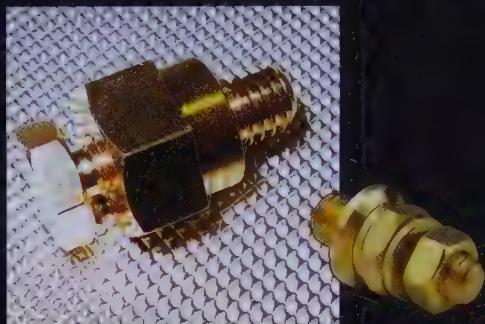
Slide the new terminal clamp onto the battery post and tighten the pinch nut or bolt securely



Strip off the insulation from the new amplifier power wire, make sure that the gauge of the power wire matches the gauge of the hole in the clamp, then insert the end of the wire into the new cable clamp and tighten the set screw securely

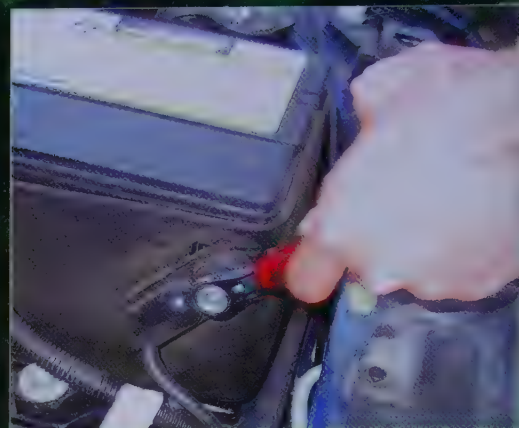
Reconnect the negative battery cable, then place the protective covers on the clamps. Transparent covers like the one shown here are not only good looking, they're practical too. They protect the terminal and clamp from dirt and moisture, and you can actually inspect the condition of the terminal and clamp without removing the cover

If the terminals are on the side of the battery . . .



If your vehicle's battery is equipped with side terminals, you'll need to add a side-mount adapter post to connect an audio power cable.

After you have disconnected the cable from the negative terminal, disconnect the cable from the positive terminal. Because they've been attached to the terminals for a long time, battery cables have some "memory" in them, which means they want to remain in the same position they're usually in, even when you disconnect them. So make sure that you not only set both cables aside but that you secure them in such a way so that they don't flop back into their connected positions and touch the battery terminals!



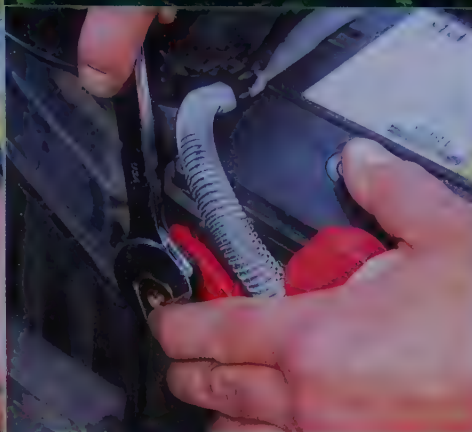
01 Start by disconnecting the cable from the negative battery terminal. Always disconnect the negative cable first! If you start by disconnecting the positive cable first, you run the risk of creating large and powerful sparks if the tool you are using to loosen the cable clamp comes into contact with a ground point on the vehicle (such as the body or other metal component). Not only can this burn you, it could also cause the battery to explode!

03 Using a screwdriver carefully pry the factory terminal bolt from the positive cable





04 Insert the adapter into the cable end . . .



05 . . . then carefully attach the cable end and the adapter to the battery

06 Once the cable end and adapter are secured, you can attach a power wire with a ring terminal on its end to the adapter . . .

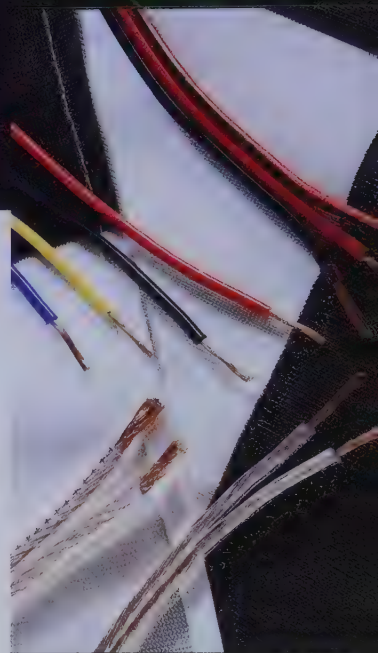
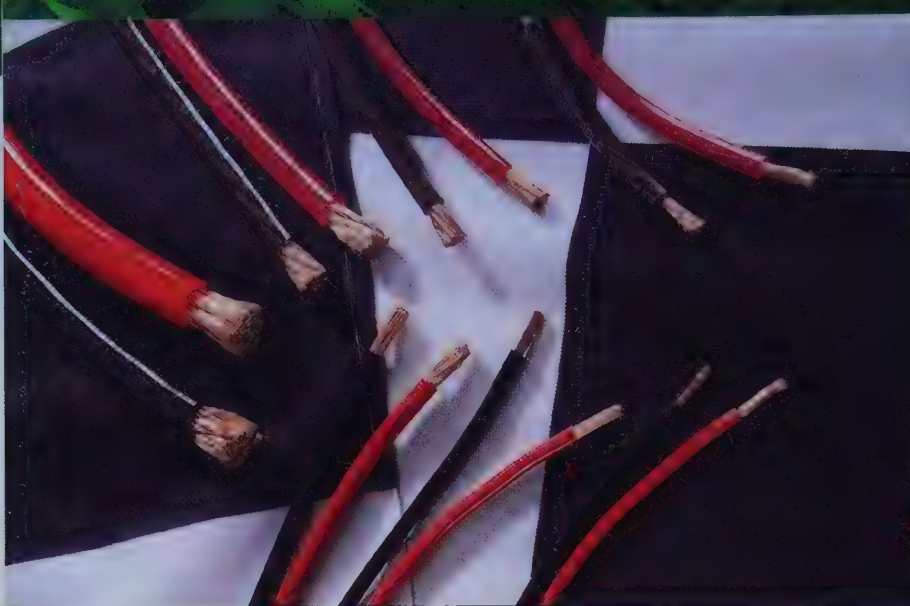
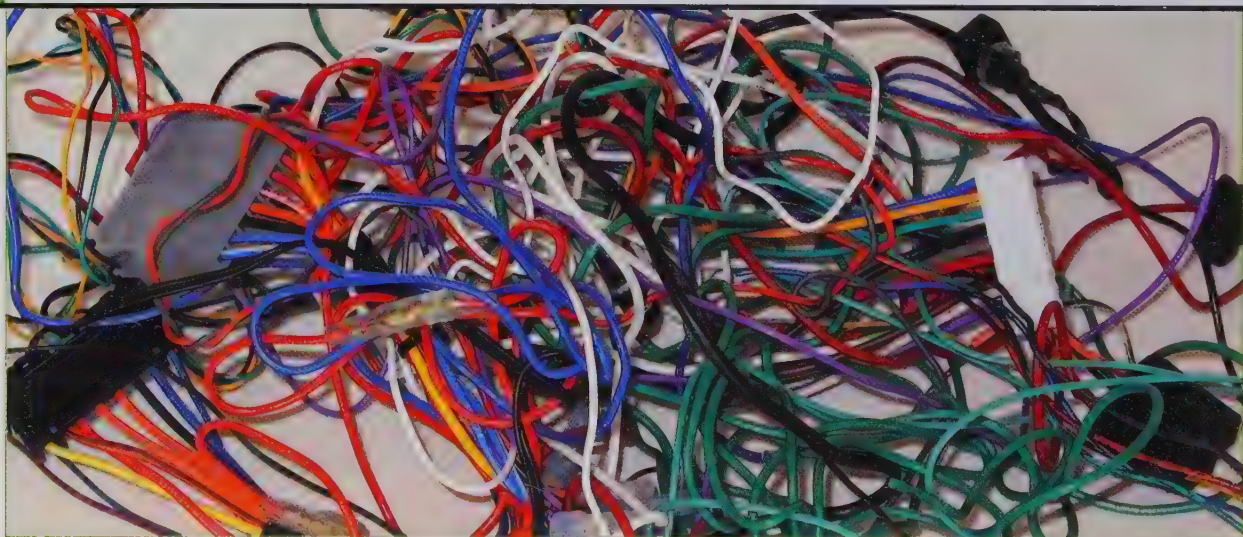
07 . . . and tighten the bolt securely



Electrical wiring and cables

Audio wiring

Until you've actually made a conscious effort to do your homework, it's difficult to appreciate the bewildering variety of special-purpose audio wiring available on the market today. The simplest wiring is constructed using one solid wire (known as single-strand wire) surrounded by some type of insulation, but this type of wire is rarely used in automotive audio installations. Like conventional wiring, audio wiring uses copper because it's the best conductor available for the money. (Silver and gold are better conductors, but way too expensive for most of us. Those for whom cost is no object occasionally use silver for very high-end audio applications. And connections are often gold-plated to provide corrosion resistance.) But copper wire is really the only similarity between audio and conventional wiring. Instead of a single strand of wire, audio wiring uses many strands or even bundles of strands. And it's often "shielded" to prevent interference from the signals in other nearby wires.





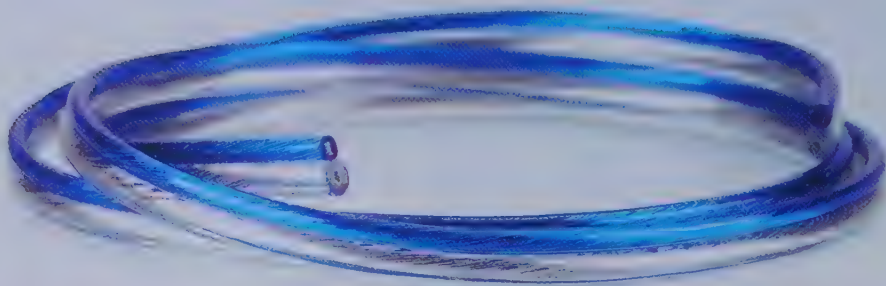
Resistance and skin effect

A couple of problems - resistance and "skin effect" - rear their ugly heads when audio or other types of mobile electronic components are wired together.

Skin effect is the rather racy name for a scientific phenomenon by which *electricity travels on the outside* (the "skin") of a *conductor*. Skin effect manifests itself in different ways depending on the application. In audio systems, it causes some distortion. Even in systems that use big gauge wires to reduce resistance, skin effect still causes some high-frequency distortion.

Now let's look at resistance, which is the opposition to the flow of current or an electrical signal in a wire. The resistance in a wire diminishes the strength of a signal as it travels through the wire. The longer the wire, the greater the amount of resistance. Resistance also causes some distortion. Single-strand wire has much higher resistance than stranded wire. If the diameter of a solid-conductor wire is too big, the signal is slightly distorted as a result of skin effect. If the diameter of the wire is too small, the resistance of the wire causes some distortion. These two phenomena overlap, so there is no perfect solution to the resistance-distortion problem regardless of which wire gauge you use.





Stranded wires

Typical speaker wire consists of two stranded wires running parallel, and attached, to one another with some type of insulation covering them. Can you say massive resistance and skin effect? Audio cable manufacturers improved the performance of speaker cables by gradually twisting the wires throughout the length of the cable. Think of holding a bundle of wires (the strands) about two feet long with your hands at either end, then twisting the ends in opposite directions and you have the idea of twisted strands. The advantage of twisted strands is that each wire gradually moves from the center to the outside of the strand, where most of the current travels. This technique significantly reduces the skin effect.

Some manufacturers also twist either stranded bundles or solid wires around an insulating core so that each of the wire strands within the bundle, or the surfaces of the single-strand wires is slowly turning, further mitigating the skin effect. And some manufacturers even insulate the bundles or solid wires, which keeps them at a certain distance from one another, preventing them from affecting one another.

Another type of audio cable consists of several twisted solid wires or stranded wire bundles arranged side by side in a parallel flat cable configuration. But the design, i.e. the twisted-strands, materials, etc. are the same as the cables described above.

Shielded cables

All of the above types of wiring are available with shielding, which simply protects the wires inside a cable from radio frequency interference (RFI) caused by other audio (usually power) cables or by noisy engine or chassis electrical harnesses. Shielding is particularly important if you're going to install an audio system in a car with a noisy electrical system or if you're going to have to route speaker cables too close to power cables. You can also obtain shielded power cables to prevent them from emitting harmful RFI that will interfere with any nearby low-power cables.

Coaxial cable

Perhaps the most common type of shielded cable is coaxial cable, which uses a center conductor surrounded by an insulating "dielectric" (non-conducting) material. The dielectric material is surrounded by yet another layer, a braided copper wire shielding. And the dielectric is surrounded by an outer layer of insulating material. You have most likely seen coaxial cable before even if you didn't know what it was called or how it was constructed. That's because all cable TVs use a coax cable from the cable outlet at the wall to the back of the television set. Coax cables for audio applications are available in a wide variety of types and designs.

Some general wiring guidelines

Decide where you're going to put each component

Before starting installation of a new sound system, first *decide where you are going to put each system component*. Then make a sketch of the entire system, including the components, the wiring and the connectors. Once you have made your own simple wiring schematic, it's much easier to sort out how and where you're going to route the electrical wires and cables connecting all these components. It also makes it easier to correctly estimate how much of each type of wire or speaker cable you'll need. And it will help you determine what types of connectors, and how many of each, you'll need.

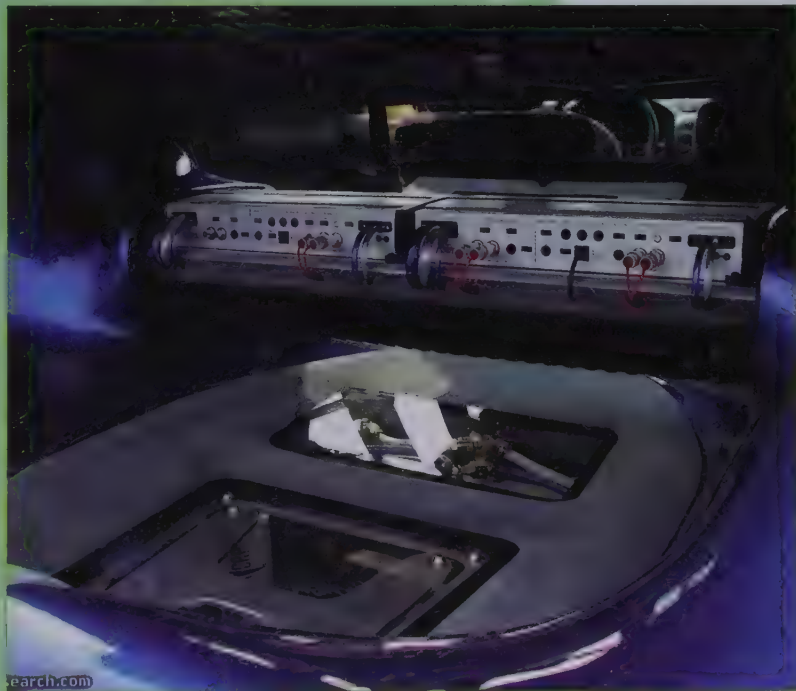


Use high quality wiring and speaker cables

When buying electrical wiring for power and signal cables, remember that poor system wiring can induce noise and cause overall poor performance, so don't skimp too much when it comes to your wiring. Automobiles generate some serious electromagnetic fields that mobile electronics systems can "receive" if their wiring uses cheap RCA (coaxial) cables with low quality shielding. Any time you mix low-power signal wires with high-power amps, you run the risk of accidentally creating an "antenna" that will "receive" this electromagnetically induced noise and feed it right into your amps and speakers. Typical symptoms include buzzing and whining noises as the engine revs rise and fall, or a ticking sound when you activate your turn signals. Low-quality cables and wires aren't the only source of this noise, but they are one variable over which you have some control. And good quality wires can simplify troubleshooting, because then you know that the wires themselves are not the problem.

Separate the power and signal cables

Always route power and signal cables so that they're physically separated. Power cables can induce noise in the low-power audio cables. The usual strategy for keeping them separated is to route the power cables along one side of the car and the low-power cables along the other side. If it's impossible to route the cables along the opposite sides of the floor, at least keep them separated by the transmission tunnel. Also, it's critical that you keep all low-power audio cables away from any other big electrical harnesses. Many modern vehicles already have a jungle of wiring underneath the carpeting. These wires bring battery voltage to all kinds of conveniences such as factory sound systems, power windows, power door locks and power mirrors, rear taillights, etc. Even though they don't carry as much current as aftermarket sound systems, they have just as much voltage, and can induce noise in the system.



Keep your signal wires as short as possible

Keep your low-power signal wires (RCA or coaxial cables, usually) as short as possible. The longer they are, the more likely they are to act as an antenna that can receive noise from electromagnetic sources such as the engine ignition or the power amplifiers in your sound system. If you're going to buy pre-made cables with the connectors already attached to both ends, try to get cables that are long enough, but with very little extra length. In other words, if the choice is between two pre-made cables, one of which is too short and the other much too long, you're not going to buy a cable that's too short, but you don't want to buy a cable that's too long either. Walk away from both of those options and instead buy the correct length of uncut cable, then install your own connectors.

Ground loops and ground paths

Some professionals claim that 90 percent of all noise in a system can be traced back to incorrectly grounded components. When the components in a system aren't grounded correctly, they don't "see" exactly the same ground, which produces a phenomenon known as a "ground loop." This difference in the degree of being grounded is known as "ground potential." The difference in potential between all the grounds of a system is what causes a ground loop, resulting in alternator whine.

There are several things you can do to prevent grounds from developing into "loop" situations:

- 1) Use high-quality cable with good shielding for the low-power leads between the output of a head unit and the input of a crossover or amplifier. Inferior cable with poor shielding will allow noise to radiate into the system.
- 2) Never mount an amplifier or any other component to bare metal. Try to use an amp rack and then insulate all the other components from the vehicle chassis.
- 3) Don't ground several components to chassis ground through their ground lines. For example, some pre-amp units get their ground connection directly from the interconnect cable; connecting the black wire to ground on one of these units sets up an automatic ground loop. Also, if your pre-amps have a power supply ground that's separate from their signal ground, ground them to one point - usually the back of the radio.
- 4) Unless there's some kind of severe grounding problem with a vehicle, don't use antenna ground-breakers. The antenna ground is absolutely essential for AM reception.

The best strategy for avoiding these types of problems is to never share a ground connection with the vehicle's accessory ground path, such as a fan motor or a brake light ground. (If you do, you'll hear a pop or buzz whenever the fan is turned on or the brakes are applied!) Instead, ground everything through a single ground path to the negative side of the electrical system. In other words, connect the ground terminals for the head unit, the pre-amp(s), power amp(s), equalizer, crossover, etc. and then route one heavy-gauge ground wire to a point on the frame or unibody that will provide a resistance-free path back to the battery. And if you want to be really thorough, simply ground everything right to the battery itself.





Finding a good ground

Try to avoid using ground points that are secondary body or chassis components (the hood, the trunk lid, the doors, etc.). They might have tack welds or fasteners between the main and secondary body parts that produce higher resistance in the ground path back to the battery. Also try to avoid using ground points that share connections with other vehicle accessories. This will help you avoid potential noise problems.

Always avoid using the factory head unit power and ground wiring. The wire gauge is (usually) too small. And it often doesn't go directly to ground, but instead picks up the grounds for other vehicle systems, all of which are gathered together at one ground point. Even though many standard head unit installation procedures specify a "factory harness adapter," systems with signal processors, multiple amplifiers and/or significant amounts of head unit power might be more prone to noise-related problems by using factory head unit wiring. This can produce clicks and pops in an audio system when other vehicle systems are switched on and off. Factory wiring also usually runs in harnesses that are located in close proximity to other electrical devices in the car that can radiate or couple noise into an audio system.

The best ground point on a vehicle is always some location *with a good physical connection to the same metal shared by the battery ground*. It doesn't necessarily have to be physically connected to the battery ground itself (but make sure that it has the same ground potential as the battery). Think of the chassis and body metal of the vehicle as one very large gauge-"wire" connecting the ground of the battery to every grounded electrical accessory.

When grounding a component, scrape off the paint around the area you have chosen as your ground point and always use a star washer to make a good electrical connection. Star washers are better than flat washers for grounding because flat washers trap contaminants between themselves and the grounding surface, which increases contact resistance. Star washers also tend to "bite" into the grounding surface, which means the contact area between the washer and the body metal has more surface area, which means lower resistance.



Speaker wires and impedance

So-called "premium" speaker wires offer you improved "depth" and "clarity," "better dynamic range" and "tighter, deeper bass." Listening to the advertising hype about speaker wires, you'd think that "time-correct windings," "magnetic flux tube construction," "linear polyethylene dielectric," etc. are behind all this goodness. What you won't hear from the advertisements is that these benefits actually accrue from using the correct wire gauge. In addition to proper shielding, proper wire-gauge size is critical for speaker wires to assure proper speaker performance.

Amplifier	Speaker wire length	Wire gauge
All wattages	Up to 12 feet	#16-2
All wattages	Up to 20 feet	#14-2
All wattages	Up to 30 feet	#12-2

As you can see, the wire gauge depends on the length of the cable: the longer the wire, the higher the resistance (and impedance) so you must compensate for the added length by installing wire of a larger gauge. Consider these gauge recommendations a starting point – when in doubt, go larger (smaller gauge number).

Interconnects

Most head units have a set of "RCA" jacks on the back that output a low-level signal. These jacks allow you to feed the signal from the head unit to an external amplifier. A high-level signal (such as the wires that run from the head unit) would overload an amp and this would likely lead to serious damage. If you're planning to run a separate amplifier, make sure that the head unit is equipped with a set of RCA outputs. Some head units have several pairs of RCA jacks, which allows you to hook up the head unit to more than one amp.

Interconnects (also known as "patch cables," "patch cords," "RCAs" and "signal cables") are not just used for carrying the low-level pre-amplified signal from the head unit to the amplifier(s). They're also used for connecting all kinds of decks (cassette, CD, DVD, video, etc.) to the head unit. On some lower-priced systems, they're also occasionally used as speaker cables. The connection itself on each end of the interconnect is known as an "RCA" (the Radio Corporation of America, which invented it). An RCA connection consists of a fat "pin" in the middle of the cable carrying the signal, surrounded by a metal barrel (which itself is usually covered in the same color plastic as the insulation on the wires). RCAs are popular with manufacturers, installers and customers because they're ridiculously easy to connect: simply plug the pin into its female counterpart on the back of the head unit, amp, deck, etc. Interconnects are available in many colors, designs, styles and configurations.

One property that is not shared by all interconnects is the degree of insulation that they provide from noise. The automotive environment is noisy, particularly if you're stringing long cables (say, from the head unit back to the trunk area), or if you're wiring a low-level (less than 2-volt) pre-amp signal source or if you're using high-power amplifiers with 100 or more watts per channel. The trouble is, cable manufacturers don't exactly specify noise immunity. If you see some marketing buzzwords like "double-shielded" or "100 percent foil shield," then those interconnects probably do have better-than-average shielding from noise. The Autosound 2000 test lab concluded that unshielded, twisted-pair cables furnish the best noise immunity in an automotive environment. But keep in mind that a noisy system is caused by numerous factors besides the type of interconnects that you use.

Another thing you *should* look for when buying interconnects to use between the head unit and the amplifier(s) is an "amplifier turn-on wire" attached down the side of the cable. This little wire, which can be used to connect the amp ON-OFF signal jack on the back of the head unit to the amp, is very handy when you're installing an amp. If you don't want to use the turn-on, you simply strip it off the side of the cable. On the other hand, if you purchase a set of interconnects *without* a turn-on already installed, and then find that you need or want one, you'll have to cut a length of 18-gauge primary wire for the amp's "remote on."

Still another thing to look for on interconnects are the directional arrows printed on the insulation jacket to indicate the direction that the signal travels (from the head unit to the amp, from a deck to the head unit, etc.). Not all interconnects are directional, but if they are you **MUST** install them with that in mind or they won't work correctly.



Recommended wiring installation sequence

Here's a good sequence to use when wiring up a new system:

- 1) Always disconnect the negative battery terminal. You don't want to damage an expensive audio component, the onboard engine management computer or some other control module by unplugging something that's still "hot."
- 2) Route the main power cables and decide where to put any fuses for those circuits.
- 3) Route the power, ground and speaker cables for each component. Be sure to leave some extra cable or wire at each end for adjustments and to give you a little slack. If you cut the cables too short, for example, you'll make it difficult to remove the head unit from the dash.
- 4) Route the interconnects (low-power signal cables). *Keep them as far away as possible from all power cables and factory wiring harnesses carrying more than minuscule levels of current.* Again, leave a little extra cable so that you'll be able to pull out the head unit later if necessary. It's better to leave the extra at the amps or other peripheral components instead of at the head unit. Coiling up extra signal cable at the head unit could cause noise problems. On the other hand, it is perfectly acceptable to bundle low-power signal cables together with electrical tape or cable ties in order to "clean up" your new wiring harness; there's no danger of signal cables in close proximity to one another causing a noise problem in adjacent signal cables.
- 5) Starting with the component that's the farthest away from the head unit and then working your way back to the head unit, make the final connections.



Fuses and circuit breakers: cheap insurance

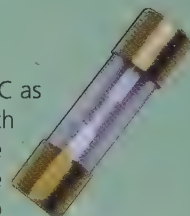
Fuses

A fuse is a device that protects a circuit from excessive current levels. It consists of a wire or a strip of metal inside a glass or plastic housing. Fuses are installed inline with power wires that might melt down if subjected to excessive current. The strip of metal inside a fuse is designed to overheat, melt and break - *before* the wire does so - if the flow of current through the circuit exceeds the current-carrying capability of the wiring. Think of the fuses as cheap insurance.

Types of fuses

AGC fuses

The AGC fuse design has been around for awhile now. Think of the AGC as the "classic" fuse. It's a strip of metal wire inside a small glass tube with metal ends (the metal ends are connected by the wire inside the tube). The wire strip inside an AGC fuse is always a little smaller gauge than the wire it protects. When used in a fuse box or fuse panel, AGC fuses are easy to install and remove. They're also a good choice for an inline fuse because of their cylindrical shape and compact size, and inline fuse holders for AGC fuses are also compact and cheap. AGC fuses are available in 1, 3, 5, 10, 15, 20, 25 and 30 amp ratings.



AGU fuses

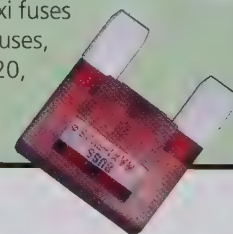
Sometimes the biggest AGC fuse isn't big enough. That's when you upgrade to an AGU fuse. Think of the AGU as a maxi-AGC fuse: a bigger strip of metal (it's actually a flat piece of metal, not a wire like an AGC) inside a bigger glass tube with bigger metal ends, capable of handling higher current levels. AGU fuses are available in 20, 30, 35, 40, 50 and 60 amp ratings.

ATO/ATC fuses

The ATO/ATC style fuse has been gaining ground for almost two decades as the fuse of choice for original factory-installed circuits and even for professional aftermarket installers. It consists of two spade terminals connected by a metal strip, which is housed inside a transparent plastic housing. Unlike the AGC fuse, which has its terminals at opposite ends, the ATO/ATC type fuse has both terminals on the same side. Because you can cram a lot more ATO/ATC fuses onto a fuse panel, there's not much clearance between the fuses, so it's difficult to remove this type of fuse without the special removal tool that looks like a pair of small plastic tweezers. The tool is usually stowed somewhere in the fuse panel. ATO/ATC fuses can also be used as inline fuses, with the proper holder. ATO/ATC fuses are available in 3, 5, 7.5, 10, 15, 20, 25, 30 and 40 amp ratings.

Maxi fuses

Sometimes the biggest ATO/ATC fuse isn't big enough. Think of maxi fuses as the big brothers to ATO/ATC fuses. Maxi fuses are "slow burn" fuses, while the ATO/ATC type are "fast burn" fuses. They're available in 20, 30, 40, 50, 60 and 80 amp ratings.





Mini fuses

Sometimes the smallest ATO/ATC fuse isn't small enough. Think of mini fuses as the little brothers of ATO/ATC fuses. They're available in 3, 5, 7.5, 10, 15, 20, 25 and 30 amp ratings.

ANL and MEGA fuses

These wafer-style fuses are for applications over 80 amps.

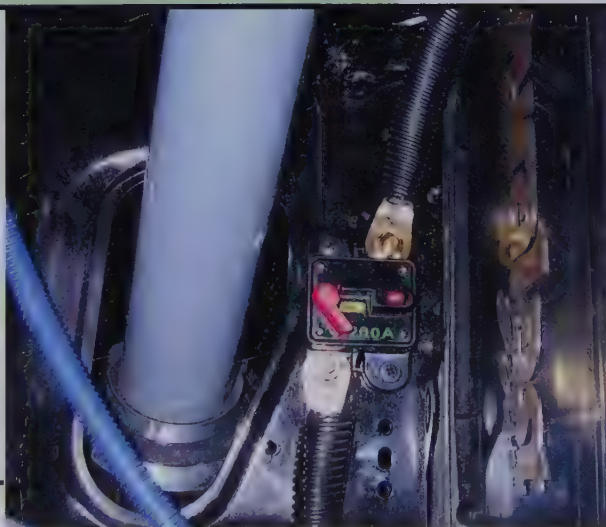
Fuse blocks and fuse holders

Always choose a fuse block or fuse holder that accepts the wire gauge you plan to use. "Distribution" fuse blocks (one input, multiple outputs) usually accept a single 4-gauge input and have two, three or four 8-gauge outputs. High-amperage fuse holders are usually designed for 4-gauge or 8-gauge inputs and outputs. If you're buying a fuse holder for the main power line from the battery, that fuse must be no more than 10 inches from the battery, so make sure that you obtain a *waterproof* fuse holder for that application. And every time you install a fuse block or a fuse holder, make sure that you put it where it will be easy to get to in the event that you have to check it.



Circuit breakers

A circuit breaker is a device placed in series with a power line which will open the power connection when an excess amount of current is sensed, thus protecting a circuit or system. Unlike a fuse, which melts its wire when the current becomes excessive, a circuit breaker can be reset. Some reset themselves, while others must be reset manually.





Connectors

Automobiles use many different types of electrical connectors for different purposes. With the increasing complexity of modern automobile electrical systems and the advent of computer control systems many new types of special connectors have emerged. And most mobile electronics projects involve lots of connectors. Let's take a look at the types of connections commonly used when installing automotive sound systems and mobile electronics: soldering, crimp connectors and quick-splice connectors.



Soldering

Soldering is generally regarded as the best electrical connection. It provides low impedance, corrosion resistance and strength. But soldered connections are time-consuming, particularly if you're the impatient type, and tricky, particularly if you're untutored. And even after you have mastered the art of soldering, sometimes you just have to employ quicker and easier ways to connect wires together.



Some general guidelines for soldering

- 1) Always slip a section of heat-shrink tubing onto one of the wires you're going to connect before you solder the connection.
- 2) Use rosin-core solder in a 60-to-40 ratio (60 percent tin, 40 percent lead).
- 3) Make sure that the connection that you're going to solder is free of dirt and corrosion.
- 4) Be sure to "tin" the soldering iron tip occasionally by coating it with solder. Then wipe off the excess with a clean shop rag until the tip is smooth and silvery.
- 5) Heat the connection, not the solder.
- 6) Use the side of the soldering iron tip near the point - not the point itself - to heat the connection. This angle allows more heat transfer from the tip to the connection.
- 7) A correctly soldered joint is smooth and silvery, not rough and gray. Rough gray joints are called "cold" joints and are caused by movement between the two items being soldered before the solder solidifies. If a joint is cold, resolder it. (If you don't, it will create high resistance at the joint and might also eventually break.)
- 8) Always insulate and weatherproof the connection with heat-shrink tubing when you're done.

Crimp connectors

To make electrical connections, many professional electrical technicians use a wide variety of crimp connectors available. Crimp connectors are not as weatherproof as soldered connections, but, when you use a special crimping tool (available at most auto parts stores), making these connections is quick and easy.

Having the right type and size crimp connector handy for the wire or wires you want to connect is key when you're installing an audio system or mobile electronic components. If you use the wrong type of crimp connector, it might unplug itself over time. If you use a crimp connector that's too big for the gauge wire you're connecting, the connector might work its way off the end of the wire. And even if it stays put, the connection between the connector and the wire might be poor, resulting in unnecessarily high resistance in the circuit.



Crimp connectors are quick and easy to install - simply strip off about 1/4-inch of insulation using the proper-gauge hole on your stripping tool . . .



. . . insert the stripped wire and crimp the connector firmly onto it using the correct crimping jaws of the tool

Crimp connectors are color coded in accordance with an industry standard as follows:

Wire gauge	Industry standard color on crimp connector
22 to 18	Red
16 to 14	Blue
12 to 10	Yellow

If you don't know the wire gauge, you can figure it out using your crimping tool by inserting the end of the wire into each of the stripping holes in your crimper until you find the one that strips off the wire's insulation. If that doesn't work, just use whichever crimping hole that fits best. And always use the "pull test" to verify that your crimp is sound.

What if the wire on which you want to install a crimp connector is too small for the connector, or one of the wires you want to connect to another wire is too small for the butt connector that fits the larger wire gauge? Beef up the thinner wire by stripping off twice as much insulation as you normally would, then fold the wire back over itself and twist it together.

And if the wire on which you want to install a crimp connector is too large for the biggest crimp connector you've got handy? Then it's time to head to the nearest auto parts store for more crimp connectors! In other words, do NOT try to "cut down" the gauge of a stripped-off wire end in order to jam it into a too-small crimp connector. You will be creating a high-resistance hot spot in the circuit that will surely overheat and might even start a fire.

The following descriptions briefly summarize some of the most popular styles of crimp connectors used by installers. There are others, but the following types of crimp connectors will enable you to make nearly any type of connection you will encounter when installing an audio system or other mobile electronic components.

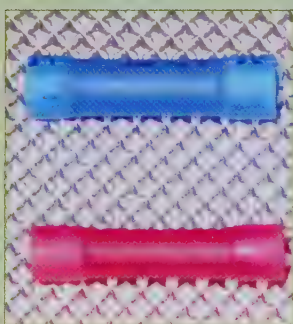


When installing spade or bullet connectors, always crimp the *female* side of the connector to the *feed* wire. This way, if the connector comes unplugged, the "hot" wire won't short out if it touches a ground (it'll be shielded by the insulation surrounding the female side of the connector).

Butt connectors

Butt connectors are used to permanently connect two wire ends together. Simply strip off about 1/4-inch of insulation from each wire,

insert the stripped ends of both wires into the opposite ends of the connector and then "crimp" the butt connector with a crimping tool. To verify the soundness of the connection, try to pull the two wires out of the connector.



Ring terminals

Ring terminals are used at the end of a wire or cable to make a secure connection to grounds, terminal blocks or the battery. Installed ring terminals are mashed flat by the bolt or screw used to secure them, so they make good contact (like a washer) and almost never come loose. Ring terminals are installed just like butt connectors: simply strip off about 1/4-inch of insulation, insert the stripped end of the wire into the ring terminal, crimp the terminal firmly and then give it a good jerk to see if it's going to hold. When attaching a ring terminal to the vehicle chassis or body as a ground, make sure that there's no paint or anything else between the ring terminal and the metal surface being used as a ground.





Hook terminals

Hook terminals are similar to ring terminals, but they have an open side (they're shaped like a question mark). Their advantage is that they can be connected to a terminal block more quickly than a conventional ring terminal because, while you have to loosen the screw on the terminal block, you don't have to remove it, to connect a hook terminal.

Spade connectors

A male spade connector, which looks like one of the terminals on an electrical plug, is also known as a flat-blade, quick-disconnect or push-on connector. Spade connectors are commonly used to connect accessory component wiring to the fuse panel because they're easy to plug in, and to disconnect, in tight spaces. When used with a female connector half, a spade connector also allows you to connect two wires together that must occasionally be disconnected. On the downside, they're prone to pull apart if the wiring is too tight or if there's a lot of vibration.



Here's a female spade connector next to a fuse fitted with a fuse tap. If you're using a fuse tap to supply power to an added component, make sure you install it on the "fused" or "downstream" side of the fuse. To find the proper side, remove the fuse and probe the contacts in the fuse block with a test light; the contact with NO voltage present is the proper side on which to install the fuse tap

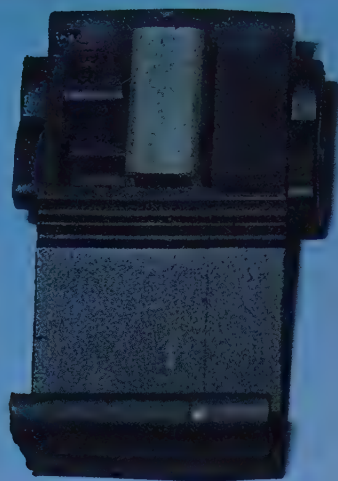
Spade tongue connectors

Spade tongue connectors look like a male spade terminal with its center notched out; i.e. they're U-shaped. Like hook terminals, spade tongue connectors are used to make connections to grounds or terminal blocks because they're quicker to hook up than ring terminals. But spade tongue connectors have the same disadvantage as hook terminals: they can come loose more easily than ring terminals.

Bullet connectors

Bullet connectors look like butt connectors except that they consist of a male and female side; i.e. they're always used in pairs. Bullet connectors are used to connect wires together that must be occasionally disconnected. Like spade connectors, they shouldn't be used to make permanent connections, because they can work themselves loose if the wires are too tight or if there's a lot of vibration present.

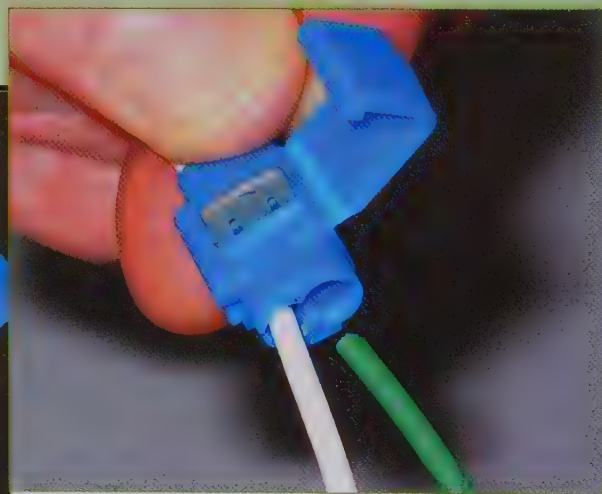




Quick-splice connectors

The main advantage of quick-splice connectors is that you don't have to strip off any insulation or cut any wires to make a connection. Simply open the clamshell-style connector, place the wire you're going to tap into and the new wire you're installing into their respective channels, squeeze the guillotine-like blade down into its slot (which slices through the insulation of both wires and contacts the metal conductors of both wires), fold the clamp over until it snaps and you're done.

To use a quick-splice connector, pass the "tap" wire through the outer channel of the connector . . .



. . . push the "run" wire (the wire that is to power the component you're installing) into the inner channel until it stops (make sure it goes past the blade, all the way to the end) . . .



Wire nuts

We know that you have probably used wire nuts somewhere, sometime. Who hasn't? Even some "professional" installers use them from time to time. And why not? To make the connection, you simply strip off a 1/4-inch of insulation from each wire, twist the exposed end of each wire, then twist the two exposed and twisted strands together and screw on the wire nut. What could be simpler?

Well, okay, wire nuts are simple to use. But our position is that, while they're fine for home wiring, where there's no vibration to loosen a connection, they're not reliable enough for automotive audio and mobile electronics installations. In the automotive environment, they can work themselves loose, then cause a short or open circuit, which could silence your system, or ruin it. Maybe you didn't know about all the other cool connectors before. Now you do, so ignorance is no excuse. Bottom line: *Don't use wire nuts in your vehicle!*

Quick-splice connectors are useful for installing power and ground wires. They're also handy for connecting an aftermarket head unit to a factory wiring harness when an adapter isn't available because you don't have to cut off the end of the harness.

Make sure that you're using the correct size connector for the wire. If you use a quick-splice connector that's too big, you'll get a poor (or no) connection. If you use a connector that's too small, the guillotine blade will slice through too many of the conductor wire

strands, weakening the wire.

Quick-splice connectors are color-coded just like crimp connectors (see the wire gauge/color code chart in Crimp connectors above). Most of them are designed to accept the same size wire gauge for both wires, but there are special connectors that will accept one gauge for the "run" wire and another for the "tap" wire, so that you can splice into a thick wire with a thinner wire.

... squeeze the blade into the slot ...



... and snap the clamp into place





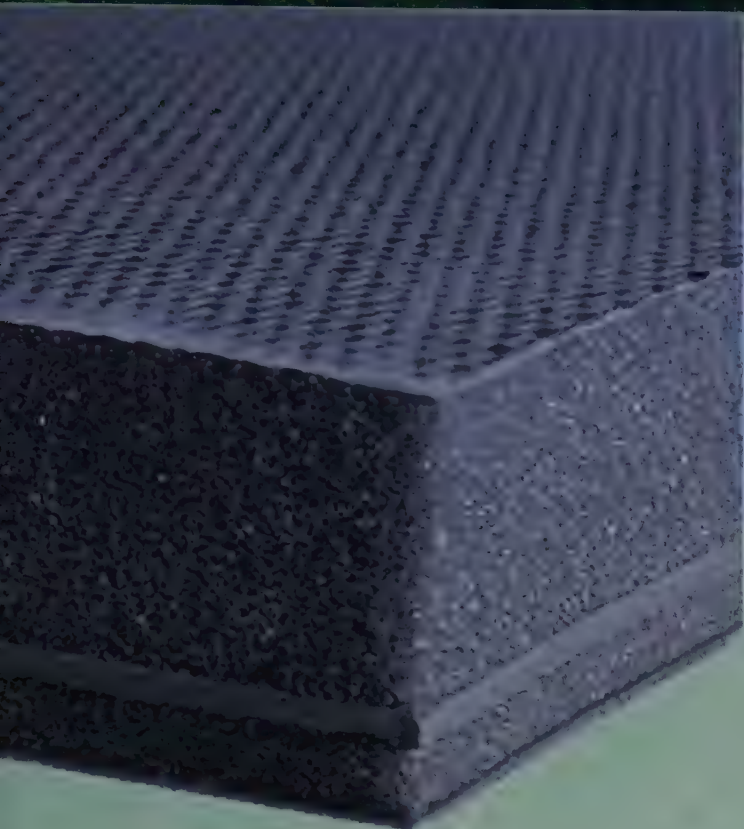
Sound-deadening materials

Bad vibrations

Installing good speakers is the most common upgrade to a sound system because the speakers are generally regarded as the weakest link in any system. But the sound quality of automotive speakers depends to a large extent on the quality of the installation, which in turn depends on the craftsmanship, skills and techniques of the installer. That's because a motor vehicle isn't really the best place to mount a speaker.

A speaker transforms electrical energy into mechanical energy, which is in turn transformed into acoustical energy, which is radiated outward (into the car and the listeners' ears). Let's call this the front wave. But the speaker also radiates acoustical energy in the other direction, too. Let's call this the back wave. The speaker frame also transmits energy into its mounting surface, which acts like a big, not-too-flexible "speaker cone." If the vibrations of the back wave and the random vibrations of the mounting surface aren't contained and controlled, you get distortion.

The only way to get the optimum performance from good quality speakers is to quiet-down the surfaces around and behind the speakers. Installing sound-deadening material in a few strategic places is one of the most cost-effective upgrades you can make to your audio system. Aside from reducing or eliminating buzzes and rattles in the doors and other areas, it will insulate the highly reflective sheet metal surfaces which act like a mirror to the back wave coming off the speakers, which then bounce back and interfere with the front wave. And although you'll never be able to transform your vehicle into a recording studio, the more interior surfaces you treat with sound-deadening material, the better results you'll get from your speakers.



02 Focal America sells Black Hole Pad, a thin (1/16 inch) black flexible viscoelastic deadening material (filled vinyl copolymer) for installing high-end speakers in the doors. First, remove the door trim panel and the plastic moisture barrier, as well as the speakers you're going to replace (refer to your Haynes manual for help). Then make sure that the surface on which you're going to apply the deadening material is free of dirt, dust and moisture. Wipe off this area with some isopropyl alcohol

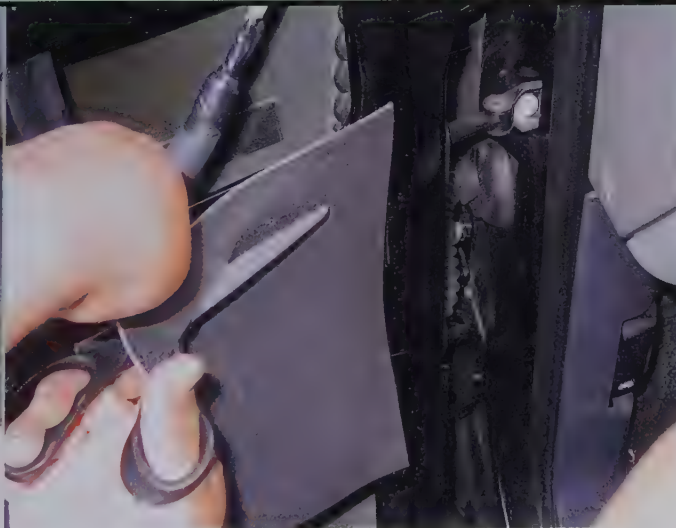
Kill the echo!

To make the material more flexible for mounting, place the material outside to allow the sun to soften it up for a few minutes before applying.

Then cut a slightly oversized piece for the speaker opening . . .

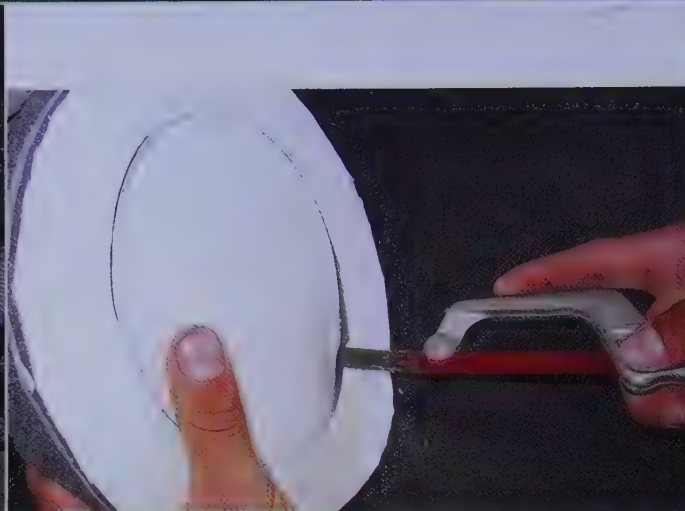
03 . . . place the oversized piece directly on the speaker opening and cut it again, to a more precise fit

Peel off the adhesive backing and apply the deadening material to the door. Using a heat gun, heat the material slightly while applying pressure to the sheet so that the material conforms to the door's surface





05 Using a razor blade, cut the material from the speaker opening



06 Focal America's Black Hole 5 is a 1-3/8 inch thick multi-layered material that dampens, isolates and absorbs sound energy. Applying a multi-layered deadening material like Black Hole 5 to the inside of a door panel or cabinet can improve the overall sound quality coming from the speaker. Start by cutting out two "doughnuts" from a sheet of Black Hole 5

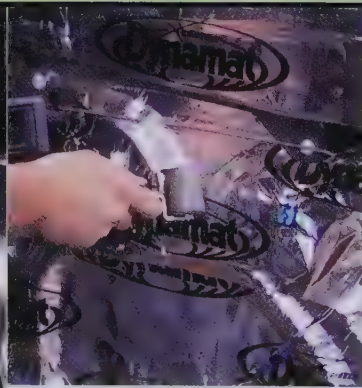


07 Remove the adhesive backing from a doughnut . . .

... then apply it to the backside of the door panel. The door is now ready for speaker installation



Another sound-deadening material is Dynamat Xtreme, installed here to the inner door panel. The door now essentially becomes a much more efficient "speaker box"



Other flat surfaces can be treated to some sound deadening material to insulate the interior from outside noise and to prevent sound waves from bouncing around when they shouldn't. Here's a sheet of Dynamat Xtreme that was applied to the rear wall of a Toyota pick-up's cab. Very easy to install - the hardest part is taking off the trim panels and cleaning the sheet metal!



Power antenna

Is your power antenna broken?
Try swapping it out with an aftermarket
power antenna replacement

Universal-fit motorized antennas are available to replace an existing, broken motorized antenna, or to install in place of a fixed mast antenna. Check out the following replacement procedure - it's general in nature, but it'll give you a good idea of what to expect.



Installing a power antenna

The vehicle on which we're replacing the antenna uses a rear-mount location on the left rear quarter panel, so we started by removing the trim panel from the luggage compartment. (If you need help with this task, refer to the Haynes manual for your car)

First, unscrew the antenna retaining nut. The special spanner wrench you see here, which is available from most auto parts stores, makes this job easier. If you can't get a hold of one, a pair of needle-nose pliers, with the tips engaged with the slots in the nut, will work

Disconnect the electrical connector from the antenna





100 Remove the mounting bolt for the old antenna mounting bracket



105 Lower the antenna and disconnect the drain tube from the bottom of the motor housing. Also disconnect the antenna lead. Now remove the old antenna



106 Remove the retainer from the old antenna . . .

Accessories and Accessories

117 . . . and install it on the new antenna



125 Carefully guide the new antenna into place



126 Install a new rubber gasket . . .





10 ... followed by the base (the installation kit should contain a variety of bases - choose the one with the proper angle to best fit the contours of your vehicle)

11 Next, install the washer and the new antenna nut, tightening it securely

12 Connect the antenna lead to the antenna connector on the new power antenna. Also connect the drain tube

13 Attach the new mounting bracket to the antenna, then bend it into shape so it's in close proximity to the mounting hole in the body panel

14 Slide on a "quick fastener" (sheet metal clip) ...

15 ... insert a sheet metal screw and tighten it securely





16 Attach the ground wire to a good ground. (Sheet metal brackets like this one are usually good ground points because they're bolted to the body, so the fasteners are usually making good contact with the body metal - if necessary, sand off some paint to get a good connection)

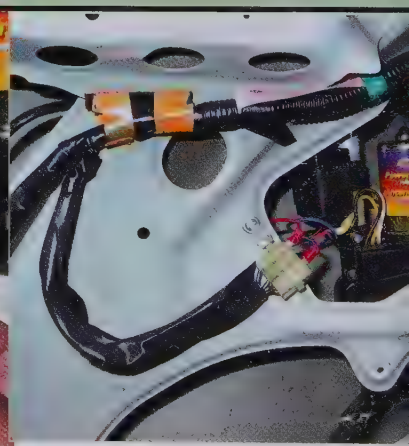
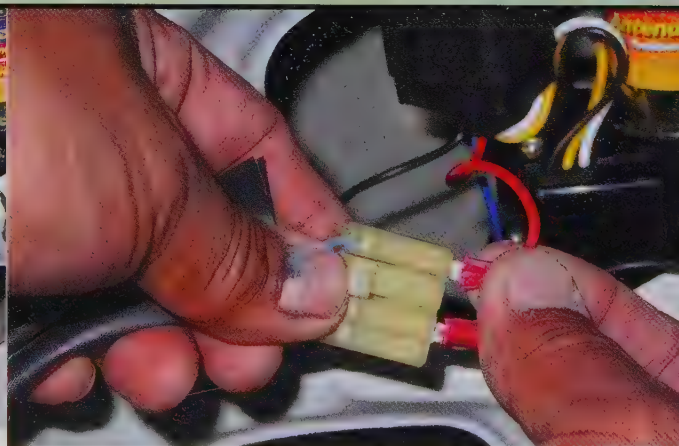
17 Grab your voltmeter. You're going to identify some terminals in the remaining half of the antenna harness electrical connector (the vehicle side of the old connector) First, find the terminal that has a constant 12-volts. This is the power wire for the antenna motor. Then find the terminal that is switched on and off when the radio is turned on and off. This is the signal wire from the radio that tells the motor to raise the antenna when the radio is turned on, and to lower it when the radio is turned off. Have a friend turn the radio on and off while you verify that the voltage goes from zero to 12V when the radio is turned on, and goes back to zero when the radio is turned off

18 Once you've identified the power and signal terminals in the old connector, set it aside for a moment and look at the electrical leads on the new antenna assembly. There should be three wires: one for power, one for the signal and the ground wire (which you've already attached to a ground). Our antenna has a red power wire and a blue signal wire (colors will vary with the manufacturer). Cut off the excess wire on each lead; leave just enough so that neither wire is too tight

19 Strip off about 1/4-inch to 3/8-inch of insulation from the end of each wire and crimp on a couple of male spade terminals that will fit the female receptacles of the old connector half

20 Plug the new spade terminals for the power and signal wires into their corresponding terminals in the old connector. Then hop in the car, turn on the radio and verify that the antenna mast goes up when you do so. Then turn off the radio and make sure that the mast goes down

21 Secure the connector to the body panel with a cable tie and generally tidy up the harness by taping or cable-tying it to the body





Power inverters

Have you ever wished that you could use your laptop or video game console in your car? Power inverters give you the ability to run 110-volt AC electrical equipment on a 12-volt DC system. Most inverters simply plug into the cigarette lighter, but if you use a laptop or video console a lot, you should consider hard-wiring the inverter into the car's electrical system. The manufacturer will include instructions for hard-wiring the inverter.

A few things to think about . . .

- Be sure to get an inverter with a power rating adequate for whatever electrical device you expect to use it for.
- If you're going to use an inverter for powering a device requiring over 150 watts, the inverter should be connected directly to the vehicle's battery using 4 gauge cable, just like you'd do if you were installing an amplifier (see Chapter 5).
- If you're powering an electrical device while you're parked with the engine off, your vehicle's battery should probably be good for about 3 or 4 hours, depending on what you're powering, and provided that the battery is in good condition. Otherwise, run the engine occasionally to keep the battery charged.
- **DON'T** try to run a big TV or a refrigerator with a typical inverter that can be obtained at auto parts stores or home electronics retailers. These devices require too much power to operate.

Security

11

Security

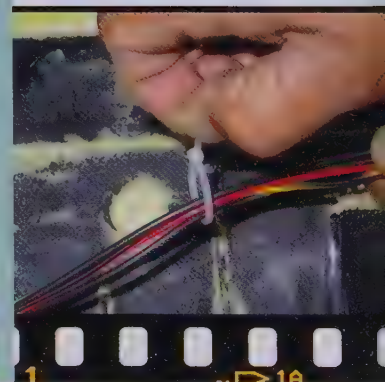


Avoiding trouble

Those shiny wheels and flashy paint are like a billboard to car thieves and bandits looking for expensive sound system components to sell on the black market. And you've got to be careful when and where you choose to show off your car's mobile entertainment, and to whom. Be especially discreet the nearer you get to home - turn your system down before you get near home, for instance, or you might draw unwelcome attention to where that car with the loud stereo's parked at night.

If you're going out, think about where you're parking - somewhere well-lit and reasonably well-populated is the best bet.

If you're lucky enough to have a garage, use it. And always use all the security you have, whenever you leave the car, even if it's a tedious chore to put on that steering wheel lock. Just do it.

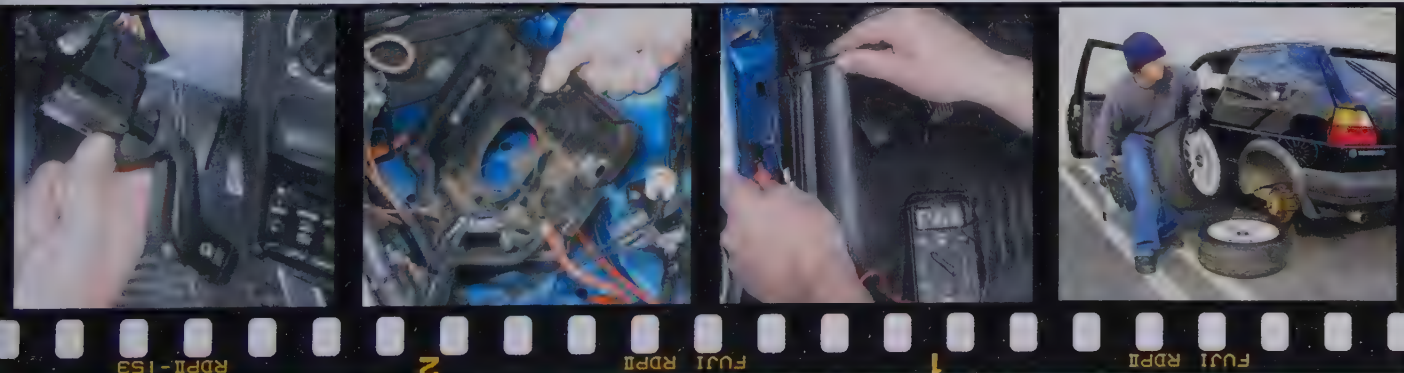




Alarm systems

There are many different types of automotive alarm systems, ranging from simple and inexpensive systems to complex and costly ones. But most alarm systems use a combination of the following components: a control unit, a siren, "switch triggers" and/or sensors, an engine "disabler" and a remote control unit. Let's take a quick look at the function of, and application for, each of these components, so when a salesman starts throwing around technical terms like "switch trigger" or "radio field disturbance sensor," you'll at least have some idea what he's talking about.

But don't rely on salesmen as your only source of information. Talk to your friends too. Ask them what type of security systems they're using on their cars, where they bought it, how much it cost, how long they've had it, how well it's worked so far, etc. Before purchasing an alarm system, be sure to give yourself plenty of time to study a system you might want to buy so that you'll understand its advantages and shortcomings when compared to other similarly priced systems. Car shows are a good place to see security systems installed on demo vehicles by the manufacturers. The people who work the shows always know most everything about the products they sell.



Control unit

The control unit is the "brain" of the alarm system. It controls all functions of the security system, such as arming and disarming the system, monitoring the switch triggers and/or sensors and processing this data to determine the threat level. If the real deal goes down, the control unit responds in accordance with the level of the threat indicated by the data from the switch triggers and/or sensors. Most control units are also capable of enabling and disabling the operation of the engine. Some units even indicate the status of the system, either through LED lights or through audible beepers. When you arm or disarm the security alarm system, the control unit chirps the siren, blinks the parking lights and/or beeps the alarm to verify that the system status has just been changed.

Siren

Electronic sirens are the most common audible devices used on alarm systems. A typical modern siren consists of an oscillator (also known as a tone generator), an amplifier and a speaker. Most sirens are shaped like a bell or horn because that shape makes for a louder siren and because it improves the pitch. Some sirens are made of metal, but most of them are high-temperature plastic.

Switch triggers and sensors

Different alarm systems are characterized mainly by what type of switch triggers or sensors they use. There are a lot of different types of monitoring devices used in various alarm systems, but they fall into the following categories. There are five types of switch triggers: spring-loaded pin switches, roller push-button switches, magnetic reed switches, metal pressure switches and mercury tilt switches. There are four basic types of sensors: motion sensors, shock and impact sensors, sound discriminators and sound sensors.

Switch triggers

The **spring-loaded pin switch** consists of a spring-loaded plastic plunger inside a cylindrical metal housing with a set of contacts at the end opposite the plunger. Pin switches typically monitor the doors, hood and/or trunk. Pin switches are normally open, but if a door, hood or trunk lid is opened while the security system is armed, they close the circuit and activate the alarm.

The **roller push-button switch** is similar to the spring-loaded pin switch except that it uses a ball or "roller" instead of a straight linear plunger to close the switch contacts. Roller switches work better than pin switches in some applications, such as sliding doors on vans or tailgates on trucks.



The **magnetic reed switch** (also known as a **magnetic proximity switch**) uses magnetic force to close the switch contacts. A pair of magnetic "reeds" (actually two thin and flexible slivers of metal), each with a contact at one end, is housed inside a glass cylinder. The reeds are insulated from each other and are attached to a stationary point at one end. Each reed is connected to a wire, which runs outside the cylinder. The reed switch assembly is protected by a plastic case. A small permanent magnet is housed inside a similar plastic case. When the magnet part of the switch is brought near the reed assembly, the reeds are moved by the force of the magnetic field to either make (normally open switch) or break (normally closed switch) an electrical connection. Magnetic reed switches are used in applications such as sliding glass windows on pick-up truck cabs.

The **metal pressure switch** (also referred to as a **seat sensor** or **floor mat sensor**) consists of two parallel strips of brass or aluminum positioned close to one another, but insulated from one another by a strip of rubber or foam with cutouts in it. When enough pressure is applied to the two strips to press them together, the rubber or foam compresses and allows continuity. The metal pressure switch is used for sensing pressure applied to a seat cushion or a floor mat. Before the advent of spatial sensors, metal pressure switches were the only devices available for protecting open vehicles such as Jeeps.

The **mercury tilt switch** (or simply **mercury switch**) consists of a set of contacts and a small amount of mercury sealed inside a glass tube. Mercury is a good conductor of electricity, so when it touches the two electrical contacts, it completes the circuit between them. The mercury switch works on the principle of gravity: When the heavy mercury moves to the end of the cylinder containing the contacts, the circuit is closed. Mercury switches are used to detect a change in the angle of a hatch or panel in relation to the horizontal plane. Typical applications include hatchbacks and hinged rear windows openings that must be moved to a steep angle with respect to the horizontal plane.

Sensors

A **motion sensor** detects (you guessed it!) motion, more specifically, the *kind* and *degree* of motion that a vehicle might undergo if it were being jacked up or being readied for towing. What kinds of motion? Subtle and near vertical up-and-down motions, i.e. the type produced by a vehicle being jacked up. Or a gradual change in the vehicle's angle in relation to the ground, i.e. the type of change that occurs when the front or back of the vehicle is lifted for towing.



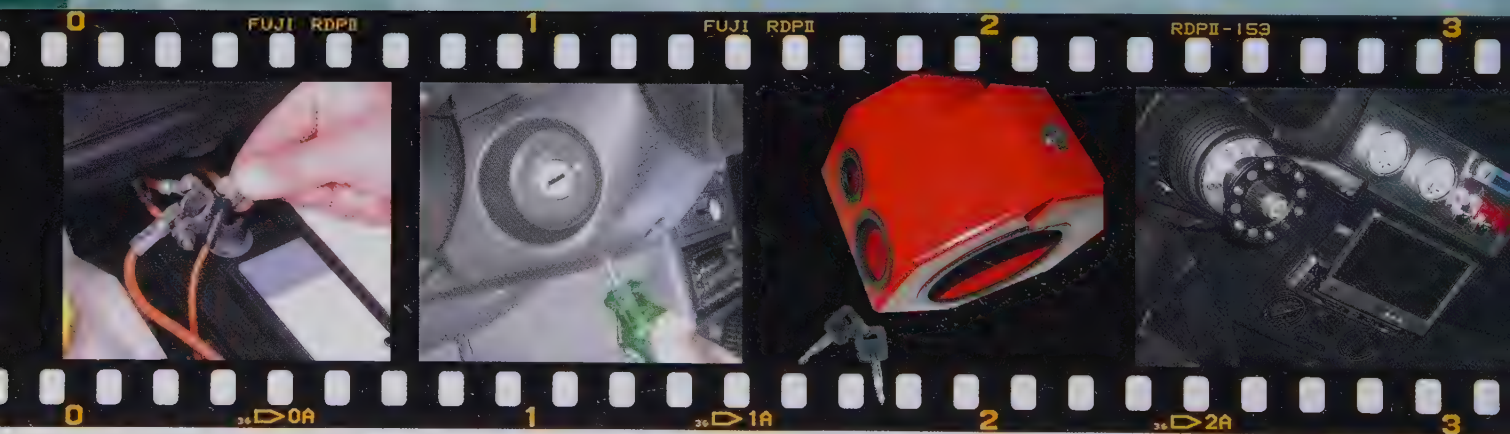
More sophisticated alarms utilize **shock and impact sensors**, which could be activated by a thief attempting to steal your tires or trying to break into your car. Shock and impact sensors react to any shock, impact or vibration applied to a vehicle. There are so many different types of shock and impact sensors that space doesn't permit a complete description of all the various types. One common design is the **two-stage electromagnetic shock sensor**. When it detects a vibration in the vehicle, it signals the control unit, which responds in accordance to the strength of the signal. The sensor delivers a "warning trigger" signal for a light impact (maybe somebody simply bumped your car) or it can signal the control unit to go into full red alert for a harder impact (like somebody trying to jimmy the door lock). The installer can adjust the impact level on some of these sensors.

The third type of sensor, the **sound discriminator** (or **glass sensor**) is designed to detect the sound of breaking glass. The typical sound discriminator uses a microphone that responds to the frequency that glass produces when it breaks. The mike is connected to a filter/sampling network, which can make a finer discrimination and then select only the signature sound of glass breaking. The circuit then goes through a "comparator" which compares the level of the sound to the sensitivity threshold setting of the sensor, then decides whether to produce a trigger or not.

Sound sensors are usually **spatial sensors**, i.e. they monitor an area of "space" in the vehicle, around its perimeter, or both. There are three types of spatial sensors: ultrasonic, radio field disturbance and infrared field disturbance. **Ultrasonic sensors** were the first sensors used in vehicle security systems. An ultrasonic sensor consists of two separate sections - the sender and the receiver. The sender unit emits extremely high frequency, or ultrasonic, sound waves (10,000 Hz to 90,000 Hz) and the receiver receives them. If someone or something of sufficient mass moves into or across the space between the sender and the receiver, the change in the sound waves caused by this interruption will cause the alarm to sound.

Radio field disturbance sensors, which are by far the most common type of spatial sensor, work essentially the same way as ultrasonic sensors, except that they use even higher frequencies, in the giga (1,000,000,000) Hertz range (that's one billion Hertz!). Radio frequencies in this range are typically referred to as "microwaves."

Infrared field disturbance sensors are less common in vehicle security applications than other spatial sensors. They use infrared waves, which are just beyond the visible red end of the light spectrum. Infrared field disturbance sensors are particularly useful in situations where the spatial sensor must ignore any changes in air pressure, such as a convertible with the top down or any other type of vehicle open to the air.



Engine disabler

The engine disabler (sometimes referred to as an immobilizer) is a device that prevents the engine from starting, or prevents it from running for more than a few seconds after it has been started. The three most common disablers are starter disablers, ignition disablers and fuel delivery disablers. A starter disabler interrupts or disables the starter circuit. An engine disabler allows a thief to operate the starter, but disables the ignition system, so the engine won't start. A fuel system disabler allows the engine to start but it cuts off the fuel supply, so the engine dies quickly.

Remote controls

Speaking of disablers, you will need a remote control unit to enable and disable the alarm system. There are three basic types of remotes: Radio Frequency (RF), infrared (IR) and inductive or magnetic. Radio frequency transmitters are the most common type of remote control unit. The transmitter uses radio waves of a specific frequency to turn various functions of the security system on and off. Most RF-type control units use a frequency between 300 and 470 MHz. Infrared or IR control units, unlike RF-types, must be operated within line of sight of the vehicle, because the infrared radiation emitted by these units travels only in one narrow straight line. Inductive or magnetic type control units don't actually "transmit" a signal; instead, they use the electrical property of "inductance" to enable and disable the system. The "range" of this type of remote unit is limited; you must pass the remote within a few inches of a special pick-up, which is usually installed on one of the windows of the vehicle.

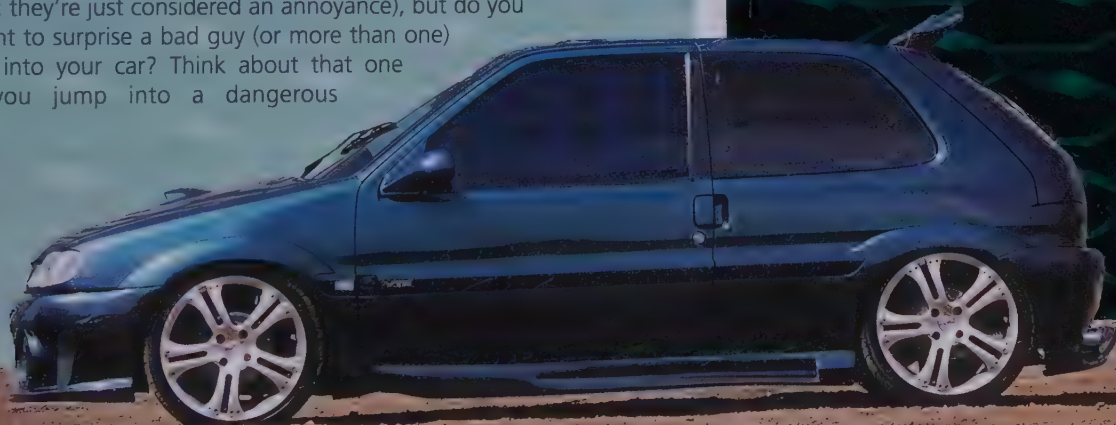
Options

Many security systems are expandable. If you purchase one of these systems, you can add on extra transmitters, sensors, switch triggers, etc. to the basic system to expand its security capabilities, either at the date of purchase or later as the need arises. Some systems offer optional conveniences such as keyless entry, power window control or remote starting capability. Some systems also offer an optional FM pager that keeps tabs on your car when you're physically too far away to hear the alarm if it goes off, or it can be set to silently page you without activating the siren in the vehicle. This can be a good feature in certain environments (how often have you heard alarms blaring and nobody even pays attention; they're just considered an annoyance), but do you really want to surprise a bad guy (or more than one) breaking into your car? Think about that one before you jump into a dangerous situation.

Tinted windows and dash protectors: cheap insurance

Got tinted windows? Good! Tinted windows not only protect your interior from harmful UV rays and keep it cooler; they also make it difficult for someone to see inside your car. Most professional automotive tinters offer four shades of tint: light, medium, dark and "limousine" (or simply "limo"), which is basically an opaque black when seen from outside. If you're planning to have your car's windows tinted, go as dark as you can get away with. The darker the better. But before plunking down your hard-earned green on a tint job, be sure to consult your local authorities regarding how dark you can legally go with the front and rear windows.

But what about the windshield? It's clear, and it's definitely illegal to tint it, so how do you prevent someone from peeking through the windshield to case your car? That's easy. Get a simple "dash protector" that you unfold and place across the inside of the windshield to block out the sun! They don't just protect your expensive dash from the sun; they also protect the contents of your vehicle's interior from prying eyes. These inexpensive devices are available at automotive parts retailers.





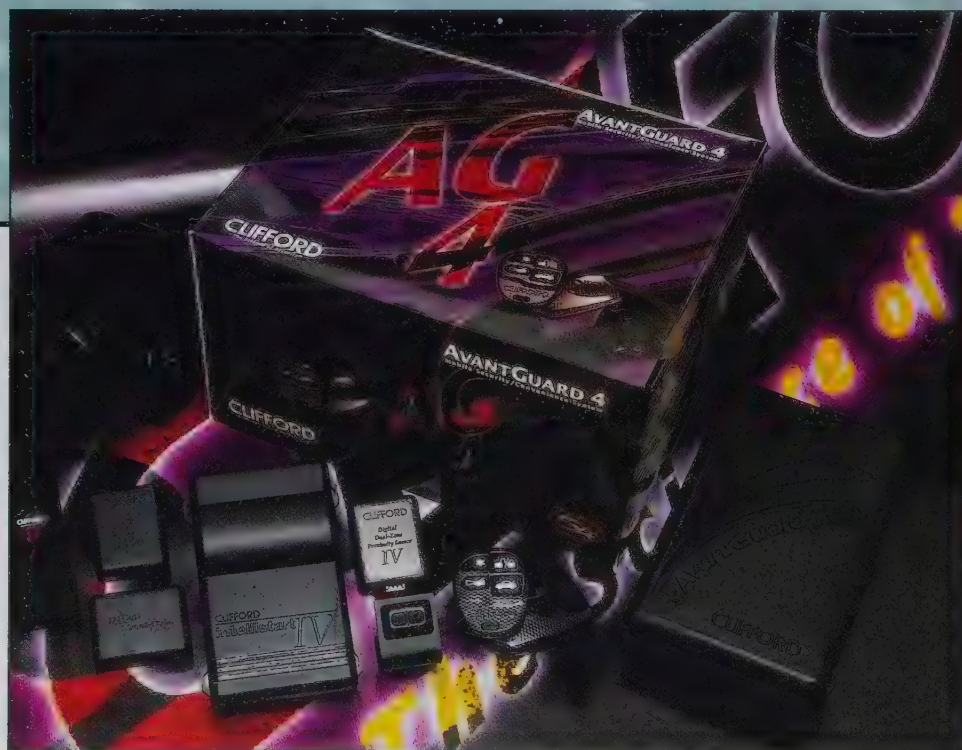
Anti-theft devices

Other types of anti-theft devices are available as a less expensive alternative to alarms.

An automobile equipped with a steering wheel lock or a removable steering wheel could make your car a less likely target for a thief. Also available are locking covers for the steering column which can help prevent a thief from being able to access the ignition lock, and devices that prevent the brake or clutch pedal from being depressed. Whatever your choice may be, now every time you park, at least you can relax a little. Remember, though, there's no guarantee that installing

an alarm or security device will make any difference to a determined thief or mindless vandal.

If your vehicle is equipped with an alarm system or an anti-theft device, you may be eligible for discounted insurance premiums. Certain companies offer a higher percentage discount for vehicles that have more sophisticated alarm system packages. Each insurance company will have their own guidelines and insurance discounts. Contact your insurance representative for all the specific details.





Installing a basic LED

It's not an alarm, but it may cause a thief to think twice about choosing your car!

An LED draws very little current, so you'll be quite safe tapping into almost any live feed you want. If you've wired in your stereo system, take a live feed from the permanent (radio memory supply) wire at the back of your head unit, or have a delve into the back of the fusebox with your test light. A ground can easily be tapped again from your head unit, or you can make one almost anywhere on the metal body of the car, by drilling a small hole, fitting a self-tapping screw, then wrapping the bared end of wire around and tightening it.

The best and easiest place to mount an LED is into one of the many blank switches the manufacturers seem to love installing. The blank switch is easily pried out, and a hole can then be drilled to take the LED (which usually comes in a separate little holder). Feed the LED wiring down behind the dashboard to where you've tapped your live and ground, taking care not to trap it anywhere, nor to accidentally wrap it around any moving parts.

Connect your live to the LED red wire, then rig your ground to one side of the switch, and connect the LED black wire to the other switch terminal. You should now have a switchable LED. Tidy up the wiring, and mount the switch somewhere discreet, but where you can still get at it. Switch on when you leave the car, and it looks as if you've got some sort of alarm - better than nothing.





Alarm installation

In order to try and make this section as useful as possible, we won't show in detail how one particular alarm is installed, but instead pick out some of the highlights and tips that are common to most systems, in case your chosen alarm is different from ours.

Disconnect the cable from the negative battery terminal, and move the cable away from the battery. This will probably wipe out your stereo settings, but it's better than having sparks flying and your new alarm chirping during installation.

Decide where you're going to mount the alarm/siren. Choose somewhere not easily reached from underneath. Try the siren in position before deciding. It's also best to pick a location away from where you'll be adding fluids to the window washer reservoir, oil to the engine or coolant to the radiator. Loosely fit the alarm to the bracket, to help you decide how well it'll fit in your chosen spot, then take the alarm away.

Mark the position of the mounting holes.





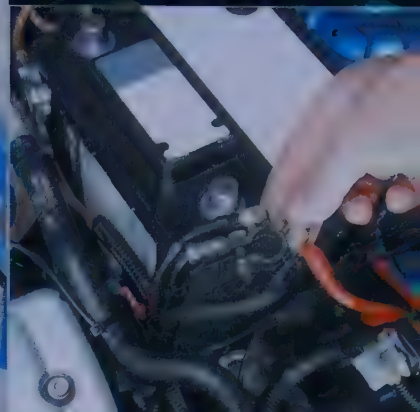
04 Carefully drill the holes (make sure there's nothing behind the panel you're drilling).



05 Install and tighten the mounting bracket screws . . .



06 . . . then slip in the alarm/siren and tighten the bolts - don't tighten them completely yet, or you might have trouble connecting the wiring.



07 The next stage is to sort your wiring. The amount of wiring, and where you'll want to run it, will depend on your alarm. If, like us, you've got a bunch of wires which should be fed into the car, you'll need to feed them through somehow. In our case, the battery had to come out - the negative cable was already off, so off came the positive . . .

. . . then remove the clamp bolt at the side, and lift out the battery - quite heavy and awkward to carry, so be careful.

Just removing the battery wasn't enough, so out came four more bolts, and the battery tray; now we can get at the firewall. It's best not to try and cut corners when routing wires through your firewall - this stuff had to come out to do the job properly, so it did.

Choosing a point in the firewall where another wire went through, we cut away some of the foam with a sharp knife. . .

. . . and, after moving inside the car, with the help of an assistant, the alarm wiring was soon poked through. It's worth sealing any holes you make in the firewall (with silicone), to reduce the chance of water getting in. Make sure any wires running into the engine bay from the firewall run down and not up, this will minimize chances of water getting into your passenger compartment.

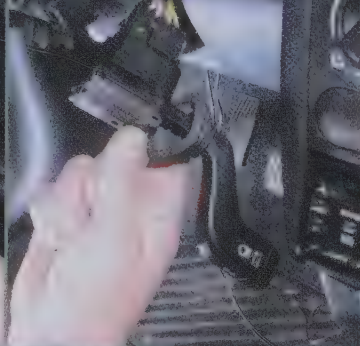
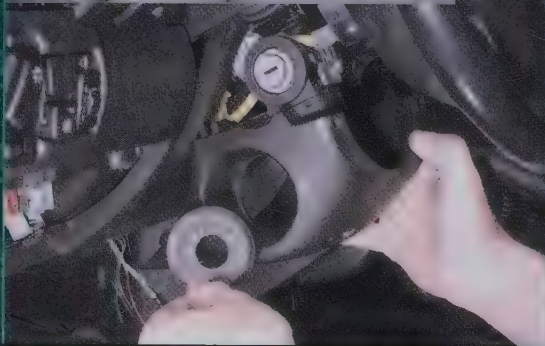
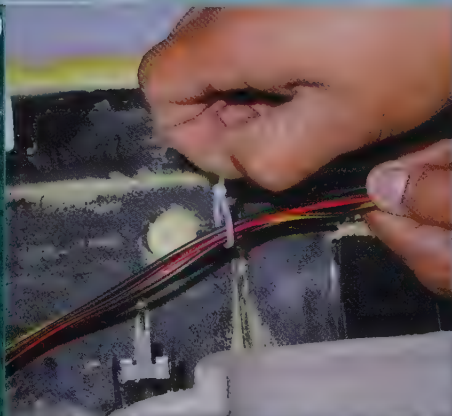


Routing the wires across the inside of the car to the fuse panel is easier if you tape them up – just a short piece of tape every few inches or so will keep them nicely bundled. Keeping the wires clear of the pedals might mean generous use of cable-ties.

Now that the wiring's more or less in the right place, it's time to start connecting it up. Power and grounds can be sourced from the fuse panel – remove the screws and lower the fuse panel from the dash. It's a good idea to refer to the wiring diagrams in the Haynes manual for your vehicle, so you know which fuse to aim for in the fuse panel, and which color wire you're after. Most of it can be decided fairly simply. When you've found a likely suspect, use a 12-volt test light (available at just about any auto parts store) or voltmeter to confirm your suspicions.

If you're after an ignition power circuit, probe the wire with the voltmeter or test light tip (or push it carefully into the back of the wiring connector) and attach the clip to a good ground (like one of the door pin switch screws) – check that it's a switched circuit, not a permanent, by turning the ignition on and off. To check for a ground, use the same method, but connect the clip to a 12-volt supply. It's best to tap into the fused side of any wire – to check for this, pull the fuse from the fuse panel, and make sure your chosen wire goes dead.

Security



19 With a bit of persuasion, we removed the lower column cover.

20 Remove the turn signal switch for access to the wiring.

21 Use a voltmeter or test light to see which wires are live when the turn signals are switched on – check both left and right-hand turn signals.



Warning:

Whenever working on a vehicle equipped with an airbag (or airbags), be sure to disable the airbag system before working in the vicinity of any airbag system components. This is especially important when working around the instrument panel and center console. Consult the Haynes Automotive Repair Manual for your vehicle for the airbag disabling procedure. If no manual exists, consult a dealer service department or other qualified repair shop to obtain the information. Also, NEVER splice or tap into any wiring for the airbag system, and never use a test light or multimeter on airbag system wiring. On most vehicles the wiring for the airbag system is yellow, or is covered by yellow conduit, or at the very least will have yellow electrical connectors.

Most alarms are wired into the interior light circuit, which is operated by push-switches mounted in the door jambs. To get the wiring, unscrew the driver's door switch or remove the screw holding the switch in place, and pull the switch out.

Disconnect the wiring plug from the switch, then use a test light to identify which of the two wires is live, and which is ground. Different alarms require you to wire into the interior light circuit on one wire or the other - check the instructions with your system.

Most alarms require you to link into the turn signal circuit, so the lights flash during arming and disarming. One obvious place to tap into the indicators is at the turn signal switch, which means removing the steering column covers.

Here we turned the wheel 90-degrees one way, then removed the screw. Turn the wheel back straight, then 90-degrees the other way, and removed the screw on the other side of the shrouds.

Check your service manual for steering column cover removal, if necessary.



The best way to connect to any existing wiring without cutting it is to solder on your new alarm wires. It's permanent, won't come loose, and doesn't mess up the original circuit. Strip a little insulation off your target wire and the end of the alarm wire. Twist one around the other, if possible.

Now bring in the soldering iron, heat the connection, and join the wires together with solder (be careful not to burn yourself, the dash, or the surrounding wires!).

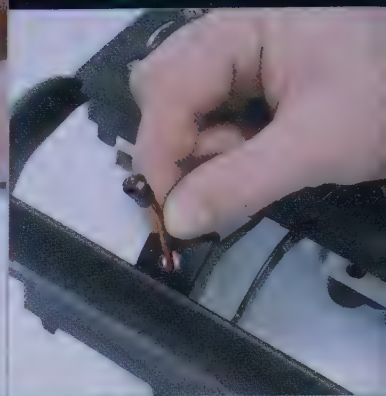
Remember - whatever method you use for joining the new wires (and especially if you're soldering) - insulate the new connection big-time. The last thing you want is false alarms, other electrical problems, or even a fire, caused by poorly-insulated connections.



25 All alarms worth having will have an LED to indicate the alarm status, and to hopefully deter thieves. The easiest option for mounting an LED is to pick one of the blank switches (if your vehicle is equipped with one), pry it out of the dash, and drill it for the LED holder. We chose to mount our new LED near where the original alarm LED was installed – in the heater panel, above the hazard light switch.



26 The LED fits into a holder, which then fits into the hole. Assemble the LED and holder before installing.



27 Here's the LED and holder being installed. We cut our LED wiring off the main loom, partly to make fitting to the heater panel easier, and partly because the standard wiring wouldn't reach. Once the panel was reinstalled, the wires were lengthened (by splicing-in an extra piece) and joined back together - you might find this approach useful, too, depending on where you're installing your LED.



31 ... then fix it in position with two bolts.



32 Drill a hole through for the pin switch plunger, and install it in the hole ...



33 ... then drill another hole for the switch mounting screw, and secure it in place. It's advisable to protect your trunk this way, too – but at least the trunk might be protected by the alarm's voltage-drop feature (if you've got a trunk light) or by the ultrasonics.



28 You must protect your hood with a "pin switch." If a thief gets your hood open unhindered, he can then attack your alarm siren and any associated wiring. Game over. Install your pin switch close to the battery, to protect the battery connections. First, make a rough platform to mount your pin switch on, then hold a pen or scribe vertically on it and have an assistant slowly close the hood. Mark where the pin switch needs to be, to work, bearing in mind the "contours" of the hood.



29 Your finished platform for the pin switch must be made of something pretty tough (metal seems obvious), otherwise it'll bend when the hood's shut. We just happened to have a nice thick piece of aluminum lying around, begging to be trimmed to size.



30 Drilling holes in your fender isn't usually a good idea. Here, it's essential. Drill through the flange at the top of the inner fender, and through your plate . . .



34 The only things left to do now are to connect the wiring from your alarm, and then to test the switch operation. The switch should be set very sensitive – the alarm should go off, the minute the hood latch is pulled. The switch plunger is usually made of plastic and can be trimmed with a knife if necessary. If you need to lengthen the plunger, fit a self-tapping screw into the top.



35 Now we're nearly there. Connect up the wiring plugs to the alarm/siren, and test it according to its instructions. Most require you to program the remotes before they'll work. Test all the alarm features in turn, remembering to allow enough time for the alarm to arm itself (usually about 30 seconds).



36 Set the anti-shock sensitivity with a thought to where you live and park - will it be set off every night by the neighbor's cat, or by kids playing football? When you're happy all is well, go around and tidy up the wiring with tape and cable-ties. There's a bit of a dilemma on the alarm fuses - if, like ours, yours are right next to the alarm module, do you tape them up, so a thief can't simply rip them out? Ah, but if you've buried them too well, you won't be able to install a new one so easily if it blows.

12

Soundoff

Soundoff

Car Audio Competition



The first known car audio competition was reported to take place in the early 1980's in a Texas parking lot. Two rival consumers wanted to prove who had purchased the loudest system in their pickup trucks. Shortly thereafter George Reed, a Texas manufacturer's representative, held a series of "Thunder on Wheels" competitions. These events were a promotion to stimulate car audio sales in his marketplace. The basis of the contest was solely focused on Sound Pressure Level (SPL) or, in other words, how loud the system could play.

It wasn't long before a group of mobile electronics industry leaders formed a brain trust to develop prudent and unbiased rules and regulations for autosound competition. These contests would evaluate the Sound Quality and Installation Integrity of a car audio system as well as judging SPL systems. This noble effort ultimately gave birth to what today is world known as the *International*

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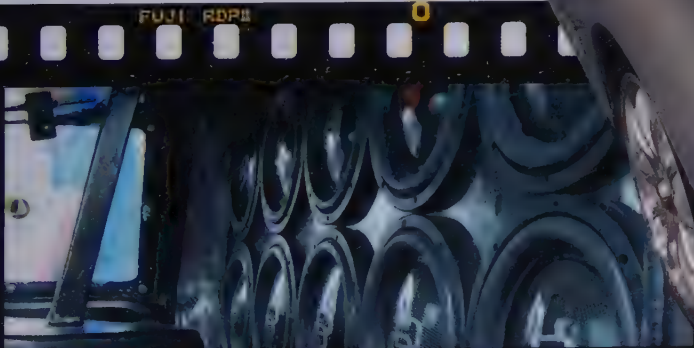
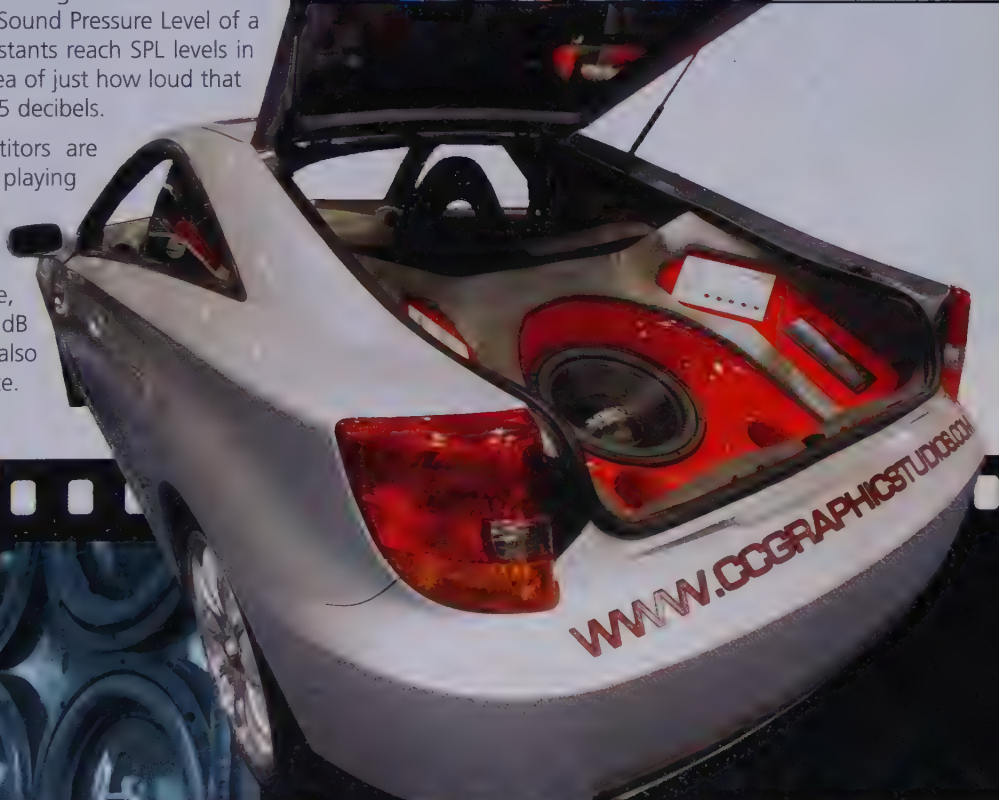
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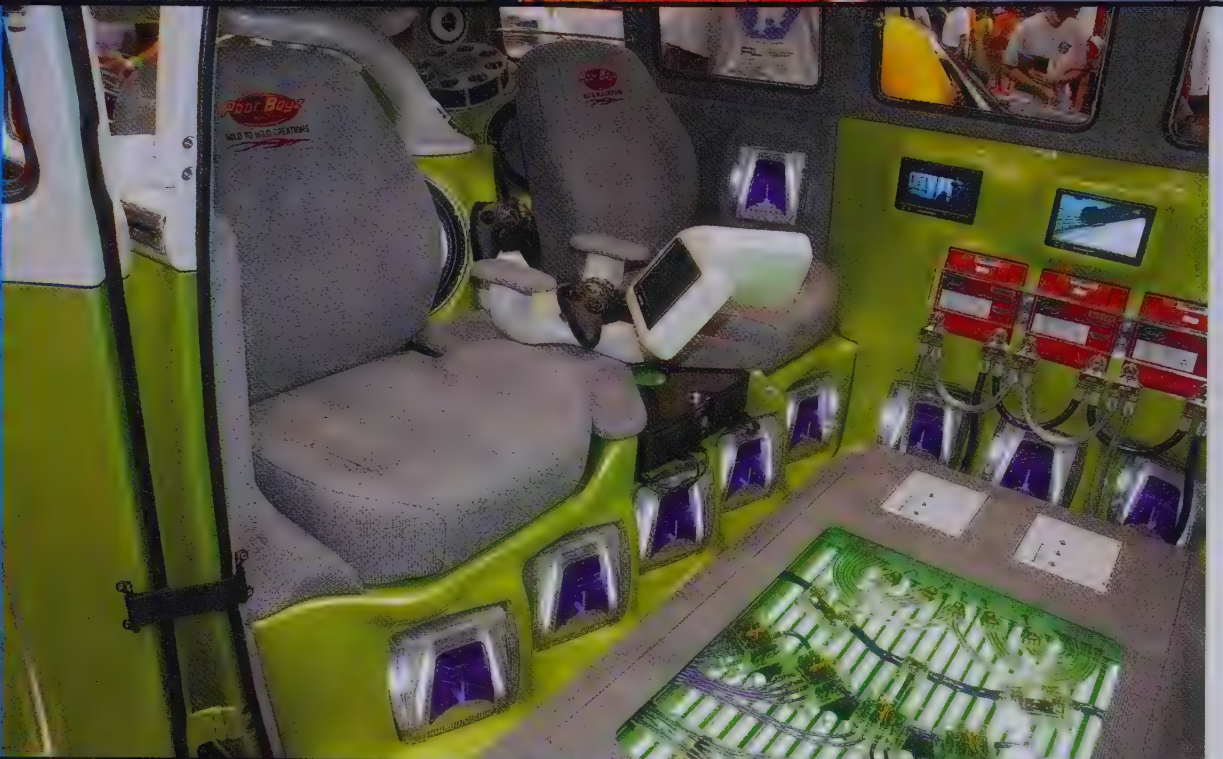
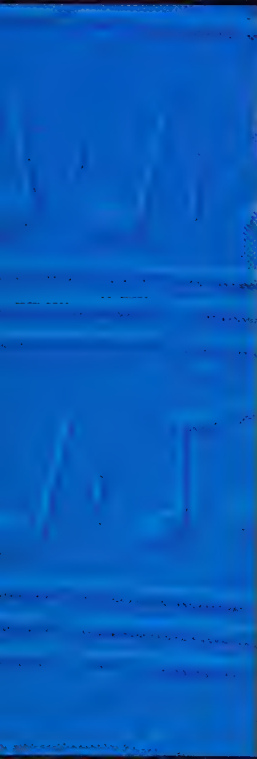


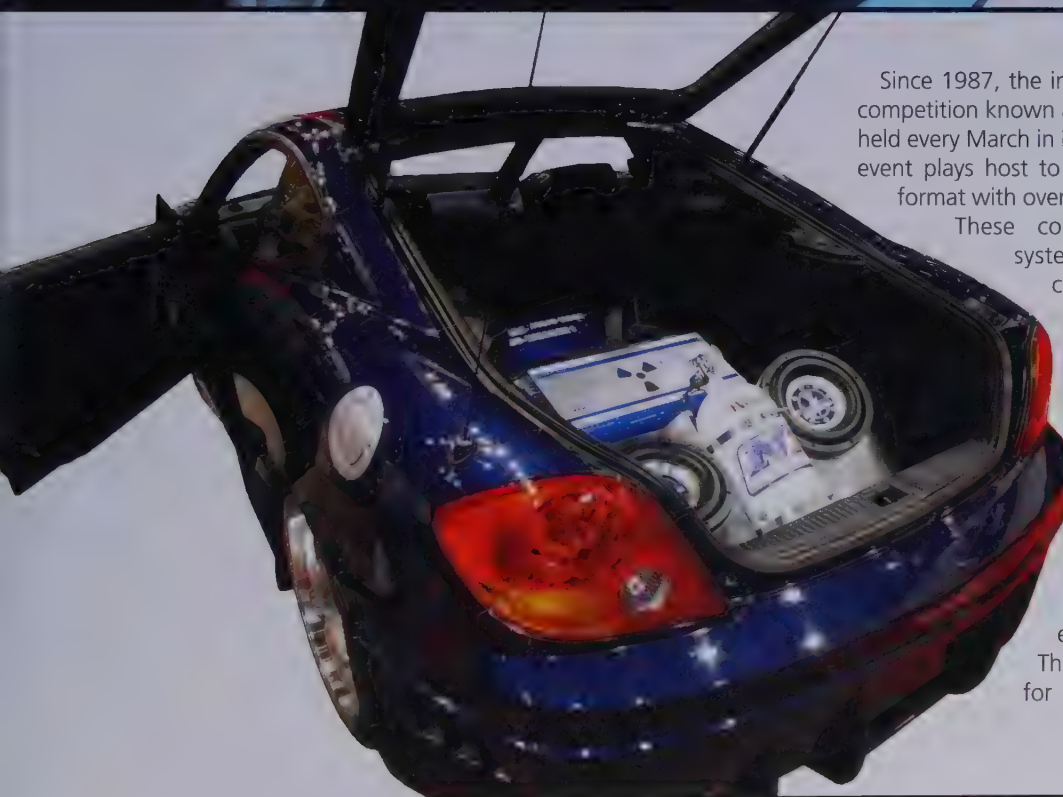
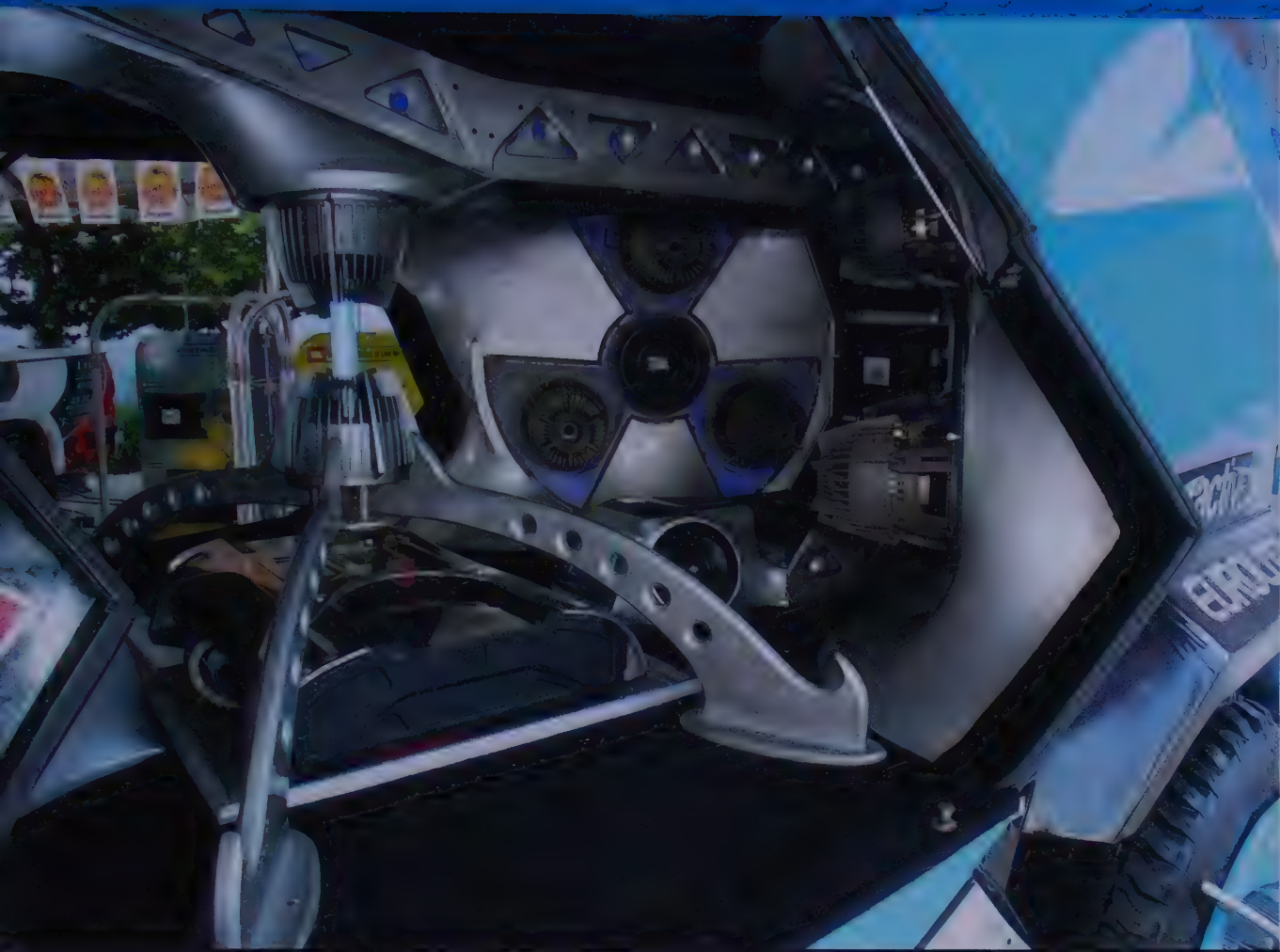
Auto Sound Challenge Association or "IASCA" (pro-nounced eye-ask-uh).

The judging criteria found in the 83-page rulebook define every aspect of critique. *IASCA* Sound Quality judging analyzes areas of tonal accuracy, sound staging, imaging, sound linearity, absence of noise and ergonomics. The Installation Judging evaluates system safety, installation integrity, cosmetic integration and creativity. In addition to this judging session, every competitor must make a presentation to the judge complete with a picture book revealing "hidden" areas of the installation to verify the neatness of the wiring and such. Objective measurements like SPL readings and RTA or "real time analysis" are included in some of the divisional classes. The SPL contest of the *IASCA dB League* uses an *IASCA* RTA/SPL meter to register the maximum Sound Pressure Level of a vehicle's sound system. Some *IdBL* contestants reach SPL levels in excess of 174 decibels. To give you an idea of just how loud that is, a jet plane (from 100 ft.) measures 135 decibels.

In the *IASCA* judging lanes, competitors are segmented into classes, which levels the playing field, therefore, Rookie competitors are not pitted against seasoned professionals in the Ultimate Division. Three divisions of sound quality competition exist: Rookie, Street and Ultimate. In the *IdBL* (*IASCA* dB League) SPL competition, three divisions also exist called: Stock, Advanced and Ultimate.



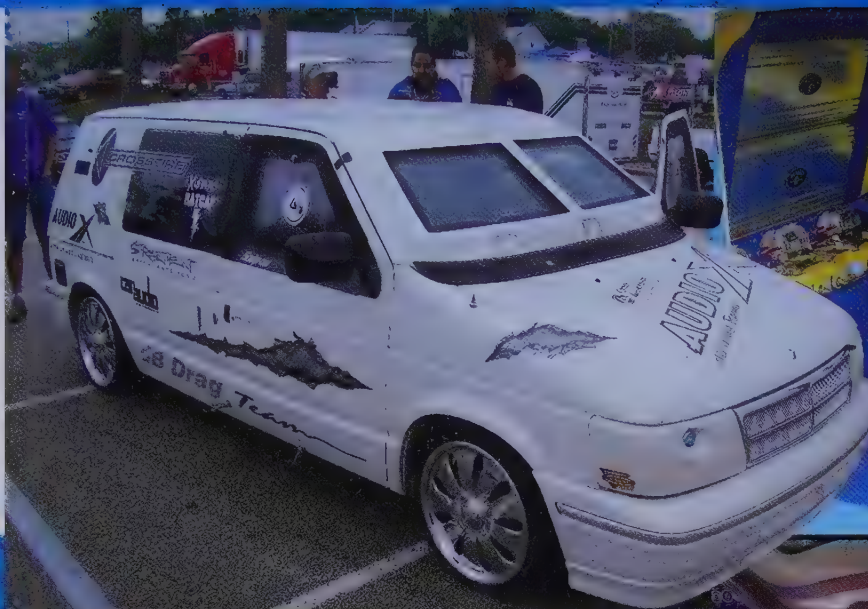


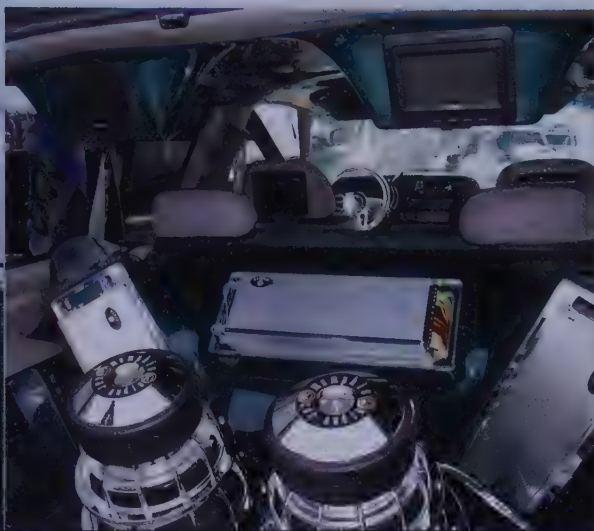
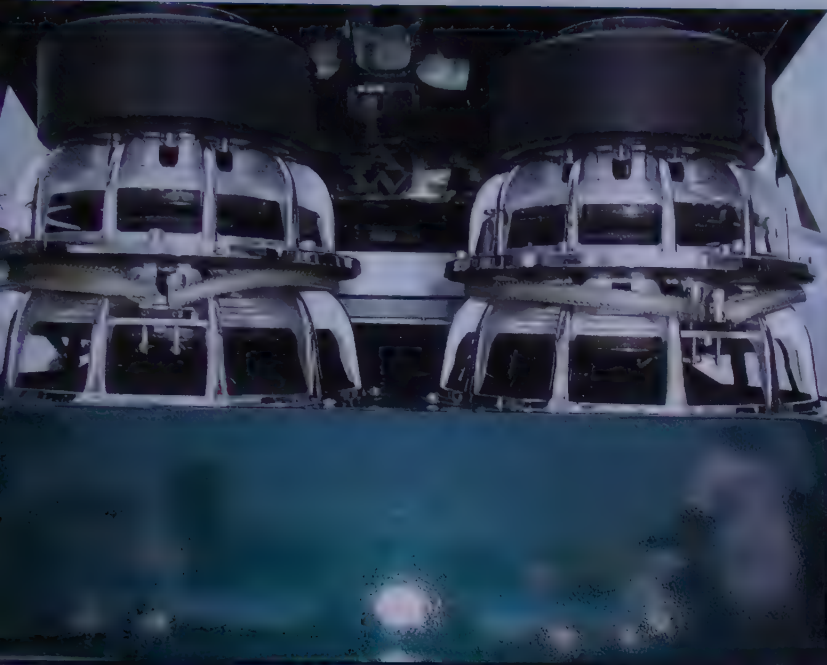


Since 1987, the industry's largest auto sound competition known as *Spring Break Nationals*, is held every March in Daytona Beach, Florida. This event plays host to every popular competition format with over 300 competitors each year.

These competition vehicles sport systems from the very basic components to the ultra-intense custom installations with price tags as high as \$60,000 plus (excluding the cost of the vehicle)! In addition to the contests, competitors join over 20,000 spectators who visit from all corners of the globe to witness over 100 mobile electronics manufacturers' exhibits in the expo center.

There are many more activities for onlookers to participate in





including \$40,000 worth of free car audio giveaways, pizza eating contests and certainly the World Famous Bikini Contests.

The excitement about the soundoff scene has spread worldwide. IASCA has affiliates in many countries on almost every continent. The competitive spirit is alive and well in today's auto sound enthusiasts. These competitors travel far and wide, pitting their systems against each other while sharing auto sound experiences building the camaraderie often seen at a soundoff. Every year members of the association meet at the World Finals Championship to see who deserves the title of best of the best. More information about IASCA and soundoff competitions can be found at www.iasca.com and www.springbreaknationals.com as well as www.meisearch.com.

Paul Papadeas, President
Soundcrafters, Inc. (retail)
Spring Break Nationals, Inc. (expo)
IASCA Worldwide, Inc. (assoc.)

*Photos by Paul Veldboom
(MEIssearch.com)*



Glossary of terms

A

AC (Alternating Current) - Energy that alternates back and forth at a certain frequency. The frequency is measured in hertz. In automobiles, AC is produced by the alternator and then rectified to DC.

Acoustical energy - Energy consisting of fluctuating waves of pressure called sound waves.

Acoustics - A science dealing with the production, effects, and transmission of sound waves through various mediums.

Active arming - A method for arming a security system that requires some action by the driver/operator. This action could include pressing a button on a remote transmitter or entering a code on a keypad.

Air horns - A type of horn that uses compressed air instead of an electric diaphragm or voice coil to produce sound. These horns are usually driven by an electric air pump that receives its trigger from a host security system.

Alarm reset - The property of an alarm system that resets the alarm to an alarmed state after a pre-determined period of time.

Alarm re-triggering - A condition that occurs in a security system that has been triggered. Instead of sounding the siren for its designated time interval, it is re-triggered and made to sound again.

Alternator - A mechanically driven automotive device that generates DC power; it is the primary source of vehicle power.

Alternator whine - A siren-like whining that occurs when an engine's RPMs increase. The noise is usually the result of a voltage differential created by more than one ground path or a poor ground path.

Ambience synthesizer - A unit that produces an artificial ambience pattern; one that is used to create the impression of the listener and/or performer being in a particular performance space.

Ammeter - An instrument used for measuring the amount of current flowing in a circuit.

Amperage - A unit of electrical current; the force through which the energy is pushed through a conductor. Measured in amps; Ohm's Law symbol is I.

Ampere - The unit of measurement used to determine the quantity of electricity flowing through a circuit. One ampere flows through a 1 Ohm resistance when a potential 1 Volt is applied.

Amplification - An increase in signal level, amplitude or magnitude.

Amplitude - The measure of how powerful sound waves are in terms of pressure.

Amplitude Modulation (AM) - A method of modulation in which the amplitude of the carrier voltage is varied in proportion to the changing frequency value of an applied (audio) voltage (see also *Frequency Modulation*).

Analog - An electrical signal in which the frequency and level vary continuously in direct relationship to the original acoustical sound waves. Analog may also refer to a control or circuit which continuously changes the level of a signal in a direct relationship to the control setting.

Analog switch - A hardware-oriented switch that only passes signals that are faithful analogs of transducer parameters.

Anode - The electrically positive pole of an electronic device such as a semiconductor. A diode, for instance, has a positive and a negative pole; these are known as the anode and the cathode.

Antenna - A mechanical device, such as a rod or wire, that picks up a received signal or radiates a transmitted signal.

Arm - The term used to describe the act of causing a security system to reach a state in which it will protect the vehicle.

Arming delay - A term used to describe the elapsed time between the moment a security system is first told to arm and the moment it is actually armed. This normally applies only to systems that are passively armed, but it can apply to actively armed systems as well.

Audio frequency spectrum - The band of frequencies extending roughly from 20 Hz to 20 kHz.

Audio signal - An electrical representation of a sound wave in the form of alternating current (AC) or voltage.

Auto reset - The ability of a security system to automatically reset itself after being triggered.

B

Back-up battery - A separate battery added to the security system as an alternate power supply to serve as a backup in case the vehicle's main battery is disabled by a thief. Back-up batteries are typically the lead-acid gel cell type and are most effective when hidden from detection.

Ballast wire - The name given to a special resistance wire used between the ignition switch and the engine's high voltage coil. This wire is typically composed of a carbon compound instead of normal copper.

Bandpass filter - A device which incorporates both high-pass and low-pass filters in order to limit and attenuate both ends of the frequency range.

Bandwidth - Refers to the "space" in the frequency response of a device through which audio signals can pass (between lower and upper frequency limits, those points where the signal level has rolled off 3 dB).

Bass - The low audio frequency range, normally considered to be below 500 Hz.

Bass reflex - A vented enclosure that allows control of rear radiated sound waves.

Battery - A device that stores electrical energy. A battery makes direct current through a collection of cells.

Bias - An unbalanced sound level.

Boomy - Usually refers to excessive bass response, or a peak in the bass response of a recording, playback, or sound reinforcement system.

Bridging - Bridging combines two channels of an amplifier to turn them into a single channel, which increases the power output of that channel.

Brain - The common term used to refer to the main control unit of a security system (see also *Control unit*).

C

Capacitor - An electronic device that stores energy and releases it when needed. Also used to direct high-frequency energy to tweeters in the form of a passive crossover. Rated in Farads.

Cell - A single unit for producing DC electricity by electrochemical or biochemical action. A common vehicle battery is composed of a number of individual cells connected together. Each cell is typically rated at 2.11 volts; a common 12VDC automotive battery is composed of six separate two-volt cells.

Channel (security) - The term used to describe the number of different functions possible for manipulating the buttons of a remote control transmitter.

Chassis - The metal frame of the vehicle.

Chirp - The term used to describe the brief sounding of a security system's siren designed to indicate the state of arm of the system.

Circuit - A closed path through which current flows from a power source, through various components, and back to the power source.

Circuit breaker - An electromechanical device designed to quickly break the electrical connection should a short circuit or overload occur. A circuit breaker is similar to a fuse, except it will reset itself or can be manually reset, and will again conduct electricity.

Clipping - Distortion that occurs when a power amplifier is overdriven. This can be seen visually on an oscilloscope, when the peaks of a waveform are flattened, or "clipped-off" at the signal's ceiling.

Closed circuit - A continuous unbroken circuit in which current can flow without interruption. Also known as a closed loop.

Closed loop - A feedback path in a self-regulating control system. Unlike a standard open state trigger that needs to have a connection established to serve as a trigger, a closed loop trigger will act to trigger a security system when its loop (connection) is broken.

Closure wire - The name given to describe a wire found on some vehicles that, when given a certain duration input, will cause the doors to lock and the windows/sunroof to close.

Code - The aspect of a security system that can be tailored by the manufacturer or the installer to personalize the particular system for a user or group of users. A remote security system that is coded will operate only with those transmitters that are coded to the same code.

Coaxial speaker - A coaxial speaker has a large cone for the low range and a smaller tweeter for the high spectrum. There is a crossover network that divides and routes the signal to the correct driver. Named for two speakers sharing a single axis.

Cone - The most common shape for the radiating surface of a loudspeaker. Often used to refer to the part of the speaker that actually moves the air.

Control unit - The central processor for a security system.

Constant output - An output of a security system that provides a constant or continuous output to drive a device. Often used for sirens and engine interrupts.

Control unit - The central processor for a security system (also see *Brain*).

Crossover - A device that separates the different frequency bands and redirects them to different components.

Crossover frequencies - The frequencies at which a passive or electronic crossover network divides the audio signals, which are then routed to the appropriate speakers.

Crossover network - A unit that divides the audio spectrum into two or more frequency bands.

Current - The rate of electrical or electron flow through a conductor between objects of opposite charge. Symbol *I*, measured in amperes or amps.

Current-fed antenna - An antenna in which the feeder or transmission line is attached to the source at a current loop. This type of antenna requires a ground plane.

Current sensing - A name given to a form of alarm system trigger that relies on sensing a change in the power supply of the vehicle. More accurately called voltage sensing, this feature is found on many inexpensive alarms.

D

Damping - The reduction of the magnitude of resonance by the use of some type of material. The damping material converts sound to energy, then disperses the energy by converting it to heat.

DAT - Digital Audio Tape

DC - Direct Current. A flow of electrons that travels only in one direction.

Decibel (dB) - The standard unit of measurement used to indicate the relative intensity of sound.

Dedicated fuse - A fuse designated to supply power and protection for one particular circuit only.

Destructive interference - A phenomenon that occurs when speakers are 180 degrees out of phase. For example, what one speaker is trying to produce, the other speaker is fighting to cancel. One speaker's wave is in the positive phase (compression), while the other speaker's wave is in the negative phase (rarefaction).

Diaphragm - A thin metal or dielectric disk used as the vibrating member in loudspeakers. Also known as a cone.

Diode - A two-electrode (two-terminal) device that allows a voltage/signal to pass through it in one direction only.

DIN - Deutscher Industrie Normen. German industrial standards that are used in many European countries. DIN size refers to the stereo size that fits most European cars.

Disarm - The opposite of arm, or the term used to describe the action of placing a security system in an inactive or standby mode.

Distortion - Sound that is modified or changed in some way. In a speaker, distortion is produced by several factors, many of which are related to poor construction. Voice coil rubbing (caused by being overdriven) is the most common cause of distortion.

DMM - Digital Multimeter. A digital meter that gives a precise reading of voltage, current, or ohms. This type of meter "samples" the input and feeds it to a digital readout.

Dolby System - A unique patented noise reduction system that electronically eliminates the irritating noise (tape hiss, circuit noise, etc.) without sacrificing the original tonal quality.

Dome light - The common term used to describe the overhead (or headliner) mounted interior courtesy light.

Door lock solenoid - The proper name for the electric bi-directional actuator used to provide powered control of vehicle door locks. Also called a *door lock actuator*.

Doppler sensor - Another name for a spatial type sensor, also commonly called a radar sensor.

Dress - The arrangement of signal leads and wiring for optimum circuit operation, cosmetic appeal, and protective routing.

Driver - Another term for a loudspeaker. Often used when the loudspeaker is coupled with a horn for acoustic coupling and controlled dispersion of sound.

DSP - Digital Signal Processing (or Processor). A type of processing accomplished by a micro-computer chip specifically designed for signal manipulation, or a component using such processing. The term is often misused as a synonym for ambience synthesizer; however DSP can do much more than sound field creation.

Duty cycle - An engineering term used to describe the actual time (or frequency) that a circuit or device operates. A pulsing alarm output that is on for seven-tenths of a second and off for three-tenths of a second would have a 70% duty cycle.

Dynamic range - The range difference between the quietest and the loudest passages of the musical selection or program signal being played.

E

Efficiency - The measurement of a loudspeaker's ability to convert power to work. Formula: Efficiency = (power out/power in) x 100. Efficiency is always expressed as a percentage.

Electrolytic capacitor - A capacitor with a negative and a positive terminal that passes only alternating current. Electrolytics are available in polarized and non-polarized configurations. Non-polarized (NP) capacitors are useful as inexpensive crossovers, blocking low

frequencies from passing through to mid- or high-frequency speakers. Polarized capacitors have specific positive and negative poles. This type of capacitor is useful for storing and releasing energy.

Emergency override - A button or switch, possibly separate or hidden from the commonly used controls of a security system, that is used specifically to override or disarm a security system in the event that the primary means is unavailable or disabled.

Engine disable - A means, either electrical or mechanical, of preventing the vehicle's engine from either starting or running. The most common variety of engine disable uses a simple automotive relay to inhibit either the starter or the ignition.

Entry delay - The time interval a security system waits before sounding the alarm after a vehicle's door has been opened.

Exit delay - The name given to the amount of time a security system waits once it's given a command to arm. Exit delays are usually found on non-remote security systems that rely on keypads or the ignition switch to arm. This delay gives the operator time to exit the vehicle before the system arms.

F

Fidelity - A term used to describe the accuracy of recording, reproduction, or general quality of audio processing.

Flashing lights - A term used to describe the interfacing of the vehicle's parking lights, dome light, emergency lights, etc., with a security system so that the lights flash by the system.

Flat response - An output signal in which fundamental frequencies and harmonics are in the same proportion as those of the input signal being amplified. A flat frequency response would exhibit relatively equal response to all fixed-point frequencies within a given spectrum.

FM - See *Frequency Modulation*.

Free air resonance - The frequency at which a speaker will naturally resonate.

Frequency - The term in physics that refers to a number of vibrations or cycles that occur within a given time.

Frequency counter - A device that assists in speaker parameter testing, as well as identifying the frequency of specific tones.

Frequency Modulation (FM) - A method of modulation in which the frequency of the carrier voltage is varied with frequency of the modulating voltage (see also *Amplitude Modulation*).

Frequency response - A term that describes the relationship between a device's input and output with regard to signal frequency and amplitude.

Fundamental frequency - The lowest frequency component of a harmonic series.

Fuse - A device designed to provide protection for a given circuit or device by physically opening the circuit. Fuses are rated by their amperage and are designed to blow or open when the current being drawn through it exceeds its design rating.

Fusible link - Designed to perform the same task as a fuse, but resembles a wire. Fusible links are commonly used in ignition switches and other high-current circuits.

G

Gain - Refers to the degree of signal amplification.

Generator - A rotating machine that produces DC electricity. Also an electronic device used for converting DC voltage into AC of a given frequency and wave shape.

Glass sensor - A device designed to detect the sound of breaking glass or metal-to-glass contact, thus triggering a security system. Also called sound sensors, glass-breaking sensors, or sound discriminators.

Ground - The term given to anything that has an electrical potential of zero. Most modern vehicles are designed around a negative ground system, with the metal frame being the vehicle's ground.

Ground loop - The term given to the condition that occurs when a voltage potential exists between two separate ground points.

H

Harmonic - The overtones and undertones that define the acoustic difference between two sounds with the same fundamental frequency.

Harness - The universal name for a bundle or loom of wires that compose the wiring for a system.

Headroom - The difference between the highest level present in an audio signal and the maximum level an audio device can handle without noticeable distortion.

Hertz (Hz) - The unit of frequency within a specific period, such as alternating or pulsating current; 1 Hz = 1 cycle per second.

High frequency - Refers to radio frequencies in the 3-30 MHz band. In audio it usually refers to frequencies in the 5-10 kHz band.

High pass filter - A network of components which attenuate all frequencies below a predetermined frequency selected by the designer. Frequencies above cut-off are passed without any effect.

Horn (Audio) - Refers to a loading device when part of a bass enclosure, or a directional device when used with a high-frequency driver or compression driver.

Horn (Security) - Refers to the built-in factory horn in the vehicle. Factory horns can be of the diaphragm type, voice coil type, or air-pump driven type (air horn). All types of horns can be interfaced to a security system.

I

Ignition kill - A device designed to prevent the vehicle's ignition circuit from operating. An ignition kill device can work by either interrupting one or both of the primary wires leading to the ignition coil or by shorting out (grounding) the ignition coil's positive primary wire. Also called Ignition disable.

Ignition power - Refers to a source of power in the vehicle, controlled by the ignition switch, that has a +12VDC on it when the ignition key is not in the run and start positions.

Imaging - The width and definition of a soundstage. Instruments should appear to be coming from their correct positions, relative to recording.

Impact sensor - A sensor designated to detect various degrees of impact or vibration applied to the vehicle and then produce an output to trigger a security system.

Impedance (Audio) - A measurement of the resistance to the audio current by the voice coil of the speaker (see also *Nominal impedance*).

Impedance (Electrical) - The total opposition offered by a device or circuit to the flow of alternating current (AC).

Inductive coupling - Radiated noise that is transmitted through a magnetic field to surrounding lines.

Inductor - An electrical component in which impedance increases as the frequency of the AC decreases. Also known as coils that are used in passive crossovers.

Infinite baffle - A loudspeaker baffle of infinite space that has no openings for the passage of sound from the front to the back of the speaker.

Infrared sensor - A type of spatial sensor that uses infrared energy to detect an object (a hand, arm, or body) entering a protected area (see also *Spatial sensors*).

Input (Audio) - The high-level (speaker) or line level (RCA) signal connections that run into one component from another system component.

Input (Security) - Any wire on a security system designed to accept a signal from some outside source such as the vehicle's wiring. Door trigger, hood trigger, trunk trigger and sensor trigger wires are all inputs.

Instant trigger - The term used to describe any trigger input on a security system that is designated to cause the system to respond instantly when triggered.

Integrity - The expected durability of a component or connection.

J

Jump - To provide a temporary circuit around a component or other circuit.

K

kHz - Abbreviation for kilohertz, or 1000 cycles per second.

L

Last door arming - A feature found on some security systems that enables the system to suspend itself from arming until the last door of the vehicle has been secured.

LCD - Liquid Crystal Display.

LED - Light Emitting Diode. A form of diode that sheds light. Used in many systems for indicator purposes.

Loudspeaker - An electro-acoustic transducer that converts electrical audio signals at its input to audible sound waves at its output.

Low frequency - Refers to radio frequencies within the 30-300 kHz band. In audio it usually refers to frequencies in the 40-160 Hz band.

Low pass filter - A network of components which attenuate all frequencies above a predetermined frequency selected by the designer. Frequencies below cut-off are passed without any effect.

M

Magnet - A device that can attract or repel pieces of iron or other magnetic material. Speaker magnets provide a stationary magnetic field so that when the coil produces magnetic energy, it is either repelled or attracted by the stationary magnet.

Memory - The word most commonly used to refer to a system's ability to retain specific information.

Microprocessor - A semiconductor that can be programmed to perform a variety of tasks in many different systems.

Midrange driver - A loudspeaker specifically designed to reproduce the frequency in the middle of the audible bandwidth. Most musical energy lies in the midband.

Milliamps - A unit of measurement of electrical current equal to 1/1000 th of an ampere. The milliamper is the most common unit used when measuring quiescent (minor) current drain.

Module - A term commonly used to describe a self-contained part of device that can perform a specific function.

Motion sensors - A sensor specifically designed to detect a gentle or sharp up-and-down or side-to-side motion of the vehicle.

Multimeter - A common term used to describe a Volt-Ohm-Meter, or VOM. A multimeter usually can measure volts, ohms and amperes or milliamperes.

N

Negative door switches - A common type of switch found on most modern vehicles which provides the trigger for the factory interior lights, key buzzer, factory alarm, etc.

Negative lead - The lead or line connected to the negative terminal of a current, voltage, or power source.

Noise floor - The noise power generated by an audio device in the absence of any input signal. It is generally measured in decibels.

Nominal impedance - The minimum impedance a loudspeaker presents to an amplifier, directly related to the power the speaker can extract from the amplifier.

Normally closed - Refers to the electrical state in which a switch may rest. Its contacts are held together or closed so that current is allowed to flow through its contacts.

Normally open - Refers to the electrical state in which a switch may rest. Its contacts are held apart or open so that no current flows through its contacts.

O

Octave - A musical interval between two tones formed with the ratio between the frequencies of the tone is 2:1.

Ohm - The unit of measurement for electrical resistance.

Ohm's Law - The statement of the relationship between current, voltage and resistance. Where $I = \text{Current}$, $E = \text{Voltage}$, and $R = \text{Resistance}$, $I=E/R$, $E=IR$, and $R=E/I$.

Open circuit - A circuit containing a switch, filament, voice coil, etc., which is not intact and current cannot flow through.

Oscillator - A device that produces an alternating current or pulsating current or voltage electronically.

Output (Audio) - The high-level (speaker) or line-level (RCA) signals sent from one system component to another, or the high-level signal from an amplifier to the system speakers.

Output (Security) - Any wire on a security system designed to produce a signal intended to be wired to some outside circuit or device. Siren wires, flashing light wires, and door locks are all outputs.

Override switch - A switch that provides a secondary means to disarm or override a security system in the event the primary means is unavailable (see also *Emergency override*).

P

Pager - A device designed to transmit a signal to the owner of a vehicle in order to alert him or her that the alarm has been triggered.

Pain generator(s) - A name given to a type of siren that is specifically designed to produce a sound of the proper volume and pitch so as to cause physical pain to a thief's ears.

Panic - The name given to the feature of a security system that provides the ability to the operator to cause the system's siren to sound at will. The panic feature is typically initiated either by pressing a button or buttons on the remote control transmitter by keypad command, by push button or by toggle switch.

Parallel wiring - A circuit in which two or more devices are connected to the same source of voltage, sharing a common positive and negative point, so that each device receives the full applied voltage.

Passive arming - The ability of some security systems to arm without requiring any direct action from the operator of the vehicle. Passive arming is usually accomplished when the operator exits the vehicle in the normal fashion (see also *Last door arming*).

Passive crossover - An electrical circuit consisting of capacitors, inductors, and resistors designed to separate an audio signal into specific speaker groups.

Peak - An emphasis over a frequency range not greater than one octave.

Period - The amount of time required for a single cycle of a sound wave.

Phase - The timing of a sound wave that is measured in degrees from 0 to 360.

Phase shift - Frequency interaction in the crossover region of passive crossovers that can cause some frequencies to be delayed with respect to other frequencies.

Piezo sensors - A type of shock or impact sensor that utilizes the properties of the piezo electric effect inherent in some materials. A piezo sensor typically uses a piezo electric element to sense impacts or vibrations applied to a vehicle.

Pinswitch - A simple, spring-loaded mechanical switch, used in many different vehicles, that's designed to turn on interior lights when doors are opened. Pinswitches are also used in the installation of most security systems in the hood or trunk/hatch as a means of triggering the system if such points are opened.

Point of entry - The term used to describe the doors, hood, trunk/hatch, windows, sunroof, or any other point through which a thief can gain entry into a vehicle.

Polarity - in electricity, refers to the condition of being either positive or negative.

Polarity reversal - A DPDT switch connected between a pair of DC input terminals so that the polarity of a pair of output terminals can be reversed or switched.

Positive lead - The lead or line connected to the positive terminal of a current, voltage or power source.

Power door locks - The feature where door locking and unlocking is performed by some mechanical means other than human power. Power door locks may be electric, vacuum, or a combination of the two.

Power line noise - A varying AC ripple that is found riding on a DC voltage. It is recognized by a whining that varied with engine speed.

Pre-amp - A circuit that takes a small signal and amplifies it sufficiently to be fed into the power amplifier for further amplification. A pre-amp includes all of the controls for regulating tone, volume and channel balance.

Proximity sensor - A common term for a spatial-type sensor that can be either the radar, ultrasonic, or infrared type (see also *Spatial sensor*).

Pulsed output - An output of a security system usually used to flash parking lights or honk horns; it is pulsed or turned on and off by the security system.

R

Radar sensor - A common name for a type of spatial sensor.

Range (Audio) - Usually described as frequency range, this is a system's frequency transmission limit, beyond which the frequency is attenuated below a specified tolerance. Also, the frequency band or bands within which a receiver or component is designed to operate.

Range (Security) - The term used to quantify the maximum operating distance that can exist between a vehicle and the remote control transmitter. Range is usually expressed in feet or yards.

Receiver - A device designed to receive a signal or command from a source such as a transmitter.

Relay - An electromagnet switch that allows small, relatively low-level signals to operate higher amperage devices. Also used when polarity reversal is necessary.

Remote - A common name for the remote control unit transmitter used with a remote security system.

Remote start - The feature where a security system or accessory module allows the vehicle operator to start the engine using a remote transmitter without actually being inside of the vehicle.

Reset - The ability of a security system to automatically stop sounding the siren and return to an armed state after being triggered, as long as no further trigger conditions are present.

Resistance - The electrical term used to describe the property that various materials possess to restrict or inhibit the flow of electricity. Electrical resistance is relatively low in most metals and relatively high in most nonmetallic substances. Electrical resistance is measured in ohms.

Resonance - The term used to describe the tendency of objects to vibrate at certain frequencies. This can be a useful or undesirable effect, as in planned enclosure or driver resonance, or as in unplanned enclosure resonance or wall resonance.

Re-triggering - See *Alarm re-triggering*.

RF - Radio Frequency. An AC frequency that is higher than the highest audio frequency.

Ripple - The deviation from a flat response in the passband.

Roll-off - relates to the attenuation of frequencies, above or below a given point, at a specific rate.

Roof-mount antenna - A permanently-installed antenna located in the center of the vehicle's roof.

S

Scanning - The popular term given to the way a thief breaks into a remote security system by quickly and sequentially transmitting all the possible security codes of a victim's security system.

Seat sensor - A pressure activated switch designed specifically for use in detecting any pressure applied to a vehicle's seat.

Sensitivity - The rating of a loudspeaker that indicates the level of sound intensity the speaker produces (in dB) at a distance of one meter when it receives one watt of input power.

Sensor - A device designed to detect or sense an intrusion or attack upon a vehicle by monitoring such things as motion, vibration, impact, sound, or the presence of a foreign mass.

Sensor bypass - The ability of a security system to automatically or manually delete or bypass the triggers from all or some of the sensors tied into the security system.

Shock sensor - A sensor that is specifically designed to detect a shock or impact applied to the vehicle.

Short circuit - The condition that occurs when a circuit path is created between the positive and negative poles of a battery, power supply or circuit. A short circuit will bypass any resistance in a circuit and cause it not to operate.

Signal-to-noise ratio - The s/n ratio indicates how much audio signal there is in relation to noise, or a specified noise floor.

Siren - Any kind of device, mechanical or electronic, that is designed to produce a loud warning sound when triggered by a security system.

Sound - A type of physical kinetic energy called acoustical energy (see also *Acoustical energy*).

Sound Pressure Level (SPL) - An acoustic measurement for the ratios of sound energy. Rated in decibels (SPL, dBA, SPL dBC).

Soundstage - see *Staging*.

Sound waves - Fluctuating waves of pressure that travel through a physical medium such as air. An acoustic wave consists of a traveling vibration of alternate compressions and rarefactions, whereby sound is transmitted through air or other media.

Spatial sensors - Devices specifically designed to detect intrusions into or around the vehicle by monitoring the space in and around the vehicle for intruders. These sensors work on a variety of different principles, including ultrasonics, radar, radio frequency, and infrared.

Spider - A flat, round, springy device that holds the vibrating cone of a dynamic loudspeaker. The spider is where the diaphragm meets the voice coil.

Staging - The accuracy with which an audio system conveys audible information about the size, shape and acoustical characteristics of the original recording space and the placement of the artists within it.

Starter disable - Any circuit or device used alone or in conjunction with a security system that is designed to prevent the vehicle's starter from operating.

Status - The state a system is in at any given time.

Subwoofer - A loudspeaker made specifically to reproduce frequencies below 125 Hz.

Switch - A switch is any form of mechanical, electronic, electromechanical, magnetic, or mercury device that either opens or closes a circuit.

Switch sensing - Refers to the inputs on a security system designed to detect a switch closure from such triggers as a door, hood, or trunk/hatch pinswitches.

System reset - See *Reset* and *Alarm reset*.

T

Total Harmonic Distortion (THD) - Given as a percentage, a measurement of how much a device may distort a signal. Figures below 0.1% are considered to be inaudible.

Transceiver - A combination radio transmitter/receiver usually installed in a single housing and sharing some components.

Transducer - Any device that converts energy from one form to another, e.g., electrical to acoustic or vice versa. Loudspeakers and microphones are two types of transducers.

Transfer function - The change in the low end of a low frequency system brought on by loading the device into the cabin of a vehicle.

Transistor - An active (commonly three-terminal) solid-state device in which a large output current is obtained by small change in the input current.

Transmitter - The name given to the hand-held remote control unit used by a vehicle operator to arm/disarm and perform accessory functions on a vehicle security system. More commonly called a remote.

Trigger - The common name for any time of stimulus that will cause a security system to produce an alarm. A trigger could come from a pinswitch, a sensor, or a direct command from a transmitter or accessory button.

Trunk release - The ability of a system to release the latch of the trunk/hatch by remote control.

Tweeter - A small loudspeaker or driver meant to reproduce high frequencies.

U

Ultrasonic sensor - A form of spatial sensor that is designed to detect an intrusion into a vehicle by monitoring the space within the vehicle with ultrasonic energy.

Unfused wire - Any section of wire between the power supply and a load that does not include the protection of a fuse or circuit breaker.

V

Valet - A word used to describe the state in which a security system may be placed in which it would be prevented from arming passively and/or actively.

Valet switch - The switch designed to provide the control to place the security system into or bring the system out of the valet state.

Voice coil - A coil of wire that takes in the electrical energy coming from the amplifier and converts it into acoustic energy or mechanical motion.

Volt - The term used to refer to the property of electrical pressure through a circuit.

Voltage - The electrical pressure produced to do work.

Voltage drop - The amount of energy consumed when a device has resistance in its circuit. The voltage (E) measured across a resistance (R) carrying a current (I). $E=IR$ (see also *Volt*).

Voltage sensing - A name given to a form of alarm system trigger that relies on sensing a change in the voltage of the vehicle.

VOM - Volt-Ohm-Meter, sometimes called a Volt-Ohm-Multimeter. A multimeter that measures voltage, ohms, and milliamperes.

W

Watt - The basic practical unit of measure for electrical or acoustical power.

Wattage - Electrical power.

Wave - A single oscillation in matter (e.g., a sound wave). Waves move outward from a point of disturbance, propagate through a medium, and grow weaker as they travel farther. Wave motion is associated with mechanical vibration, sound, heat, light, etc.

Waveform - The shape of a wave.

Wavelength - The length of distance a single cycle or complete sound wave travels.

Window roll-up - The term used for the feature that causes the window(s) on a vehicle to close upon arming, or open and close as part of a convenience feature of a security system.

Woofers - A large dynamic loudspeaker that is well suited for reproducing bass frequencies.

X

Xmax - The distance a speaker cone can travel before that magnet loses control over the voice coil.

Z

Zero output - The absence of output signal or output power.

Zone - The specific area of the security system's coverage, or a term used to describe a specific trigger input.



Safety First

Regardless of how enthusiastic you may be about getting on with the job at hand, take the time to ensure that your safety is not jeopardized. A moment's lack of attention can result in an accident, as can failure to observe certain simple safety precautions. The possibility of an accident will always exist, and the following points should not be considered a comprehensive list of all dangers. Rather, they are intended to make you aware of the risks and to encourage a safety conscious approach to all work you carry out on your vehicle.

Essential DOs and DON'Ts

DON'T rely on a jack when working under the vehicle. Always use approved jackstands to support the weight of the vehicle and place them under the recommended lift or support points.

DON'T attempt to loosen extremely tight fasteners (i.e. wheel lug nuts) while the vehicle is on a jack - it may fall.

DON'T start the engine without first making sure that the transmission is in Neutral (or Park where applicable) and the parking brake is set.

DON'T remove the cooling system pressure cap from a hot cooling system - let it cool or cover it with a cloth and release the pressure gradually.

DON'T attempt to drain the engine oil until you are sure it has cooled to the point that it will not burn you.

DON'T touch any part of the engine or exhaust system until it has cooled sufficiently to avoid burns.

DON'T siphon toxic liquids such as gasoline, antifreeze and brake fluid by mouth, or allow them to remain on your skin.

DON'T inhale brake lining dust - it is potentially hazardous (see **Asbestos**).

DON'T allow spilled oil or grease to remain on the floor - wipe it up before someone slips on it.

DON'T use loose fitting wrenches or other tools which may slip and cause injury.

DON'T push on wrenches when loosening or tightening nuts or bolts. Always try to pull the wrench toward you. If the situation calls for pushing the wrench away, push with an open hand to avoid scraped knuckles if the wrench should slip.

DON'T attempt to lift a heavy component alone - get someone to help you.

DON'T rush or take unsafe shortcuts to finish a job.

DON'T allow children or animals in or around the vehicle while you are working on it.

DO wear eye protection when using power tools such as a drill, sander, bench grinder, etc. and when working under a vehicle.

DO keep loose clothing and long hair well out of the way of moving parts.

DO make sure that any hoist used has a safe working load rating adequate for the job.

DO get someone to check on you periodically when working alone on a vehicle.

DO carry out work in a logical sequence and make sure that everything is correctly assembled and tightened.

DO keep chemicals and fluids tightly capped and out of the reach of children and pets.

DO remember that your vehicle's safety affects that of yourself and others. If in doubt on any point, get professional advice.

Steering, suspension and brakes

These systems are essential to driving safety, so make sure you have a qualified shop or individual check your work. Also, compressed suspension springs can cause injury if released suddenly - be sure to use a spring compressor.

Airbag

Airbags are explosive devices that can cause injury if they deploy while you're working on the car. Follow the manufacturer's instructions to disable the airbag whenever you're working in the vicinity of airbag components. Never use airbag system wiring when installing electronic components. When in doubt, check your vehicle's wiring diagram.

Asbestos

Certain friction, insulating, sealing, and other products - such as brake linings, brake bands, clutch linings, torque converters, gaskets, etc. - may contain asbestos or other hazardous friction material. Extreme care must be taken to avoid inhalation of dust from such products, since it is hazardous to health. If in doubt, assume that they are harmful.

Fire

Remember at all times that gasoline is highly flammable. Never smoke or have any kind of open flame around when working on a vehicle. But the risk does not end there. A spark caused by an electrical short circuit, by two metal surfaces contacting each other, by a tool falling on concrete, or even by static electricity built up in your body under certain conditions, can ignite gasoline vapors, which in a confined space are highly explosive. Do not, under any circumstances, use gasoline for cleaning parts. Use an approved safety solvent.

Always disconnect the battery ground (-) cable at the battery before working on any part of the fuel system or electrical system. Never risk spilling fuel on a hot engine or exhaust component. It is strongly recommended that a fire extinguisher suitable for use on fuel and electrical fires be kept handy in the garage or workshop at all times. Never try to extinguish a fuel or electrical fire with water.

Fumes

Certain fumes are highly toxic and can quickly cause unconsciousness and even death if inhaled to any extent. Gasoline vapor falls into this category, as do the vapors from some cleaning



solvents. Any draining or pouring of such volatile fluids should be done in a well ventilated area.

When using cleaning fluids and solvents, read the instructions on the container carefully. Never use materials from unmarked containers.

Never run the engine in an enclosed space, such as a garage. Exhaust fumes contain carbon monoxide, which is extremely poisonous. If you need to run the engine, always do so in the open air, or at least have the rear of the vehicle outside the work area.

The battery

Never create a spark or allow a bare light bulb near a battery. They normally give off a certain amount of hydrogen gas, which is highly explosive.

Always disconnect the battery ground (-) cable at the battery before working on the fuel or electrical systems.

If possible, loosen the filler caps or cover when charging the battery from an external source (this does not apply to sealed or maintenance-free batteries). Do not charge at an excessive rate or the battery may burst.

Take care when adding water to a non maintenance-free battery and when carrying a battery. The electrolyte, even when diluted, is very corrosive and should not be allowed to contact clothing or skin.

Always wear eye protection when cleaning the battery to prevent the caustic deposits from entering your eyes.

Household current

When using an electric power tool, inspection light, etc., which operates on household current, always make sure that the tool is correctly connected to its plug and that, where necessary, it is properly grounded. Do not use such items in damp conditions and, again, do not create a spark or apply excessive heat in the vicinity of fuel or fuel vapor.

Secondary ignition system voltage

A severe electric shock can result from touching certain parts of the ignition system (such as the spark plug wires) when the engine is running or being cranked, particularly if components are damp or the insulation is defective. In the case of an electronic ignition system, the secondary system voltage is much higher and could prove fatal.



Source List

AAMP of America/Stinger Electronics

Car audio accessories and hardware.
www.Aampofamerica.com;
www.stingerelectronics.com

Accele Electronics Inc.

Car video systems and auto security systems.
www.accele.com

Advanced Automotive Technology Autoloc

Vehicle security, remote start and keyless entry systems.
www.autotek.com

Alphasonik Inc.

High performance car audio products.
www.alphasonik.com

Alpine Electronics of America Inc.

Mobile multimedia and high performance car audio products.
www.alpine1.com

Ample Audio Inc.

High performance car audio products.
www.ampleaudio.com

ARC Audio

High performance car audio products.
www.arcaudio.com

ARPA of America

High performance car audio products.
www.zapco.com

Audiobahn Inc.

High performance car audio products, speaker systems and accessories.
www.audiobahninc.com

Audiovox Electronics Corp.

Mobile multimedia and security products.
www.audiovox.com

Blaupunkt

Mobile multimedia and high performance car audio products.
www.blaupunktusa.com

Cascade Audio Engineering

Acoustic control products.
www.cascadeaudio.com

CDT Audio Inc.

Automotive speaker systems.
www.cdtaudio.com

Cerwin-Vega

Automotive speaker systems.
www.cerwinvega.com

Clarion Corporation of America

Mobile multimedia and high performance car audio products.
www.clarion.com

Consumer Electronics Association

Consumer Electronics Association
2500 Wilson Blvd. Arlington, Virginia 22201-3834
www.CE.org
www.CE.org/mobile

Dynamic Control

Acoustic control products (Dynamat).
www.dynamat.com

Eclipse by Fujitsu Ten

High performance car audio products.
www.eclipseb2b.com

Focal America

High performance car audio products, speaker systems and accessories (Axon, Black Hole, Masa Audio Research).
www.focal-america.com

JBL

High performance car audio products, speaker systems and accessories.
www.jbl.com

JENSEN/Recoton Mobile Electronics

Mobile multimedia and high performance car audio products.
www.jensen.com/mobile

JL Audio Inc.

High performance car audio products, speaker systems and accessories.
www.jlaudio.com

Kenwood USA Corp.

High performance car audio products, speaker systems and accessories.
www.kenwoodusa.com

Kicker

High performance car audio products, speaker systems and accessories.
www.kicker.com

LoJack Corp.

Stolen vehicle recovery and security products.
www.lojack.com

Magnum

General purpose and vehicle specific enclosures.
www.magnumrocks.com

MB Quart

Automotive speaker systems.
www.mbquart.com

MECP

Mobile Electronics Certified Professional Program/Nationally recognized 12-volt installer certification program.
Consumer Electronics Association
2500 Wilson Blvd. Arlington, Virginia 22201-3834
(703) 907-7689
www.CE.org/mecp

Memphis Car Audio

High performance car audio products, speaker systems and accessories.
www.memphiscaraudio.com

Metra Electronics

Automotive stereo installation accessories.
www.metraonline.com

Mitek Corp.

High performance car audio products, speaker systems and accessories (MTX Audio, Xtant, Coustic Car Audio, Atlas Sound, DCM Loudspeakers, Streetwires, Esoteric Audio USA, SWX, Magnum).
www.mitekcorp.com

Monster Cable Inc.

Automotive audio cables.
www.monstercable.com

MTX Audio

High performance car audio products, speaker systems and accessories.
www.mtx.com

Myron & Davis

Mobile multimedia and video.
www.myronanddavis.com

Nakamichi/Nakusa Inc.

High performance car audio products.
www.nakamichi.com

Nicoll Public Relations

Lucette Nicoll
781-762-9300

Oz Audio

High performance car audio products, speaker systems and accessories.
www.ozaudio.com

Panasonic

High performance car audio products, speaker systems and accessories.
www.panasonic.com

Pioneer Electronics (USA) Inc.

High performance car audio products, speaker systems and accessories.
www.pioneerelectronics.com

Planet Audio

High performance car audio products, speaker systems and accessories.
www.planetaudiousa.com

Polk Audio

Automotive speaker systems
www.polkaudio.com

Q-Logic

General purpose and vehicle specific enclosures.
www.qlogic.com

Rockford Fosgate

High performance car audio products, speaker systems and accessories.
www.rockfordfosgate.com

SAS/Bazooka

High performance car audio products, speaker systems and accessories.
www.bazooka.com;
www.sasbazooka.com

SAVV

Mobile multimedia and video.
www.saww.com

Scosche Industries Inc.

Automotive audio installation accessories, acoustic control products, cables and wires.
www.scosche.com

Sirius Satellite Radio

Digital quality, commercial-free radio.
www.siriusradio.com

Sony Electronics Inc.

High performance car audio products, speaker systems and accessories.
www.sony.com/
www.sony.com/xplod

StreetWires

Automotive audio cables.
www.streetwires.com

US Amps Inc.

High performance car audio products.
www.usamps.com

Visonik

High performance car audio products, speaker systems and accessories.
www.visonikcaraudio.com

XM Satellite Radio

Digital quality, commercial-free radio.
www.xmradio.com

Xtant Technologies

High performance car audio products, speaker systems and accessories.
www.xtant.com

HAYNES REPAIR MANUALS

ACURA

- *12020 Integra '86 thru '89 & Legend '86 thru '90
- 12021 Integra '90 thru '93 & Legend '91 thru '95

AMC

- Jeep CJ - see JEEP (50020)
- 14020 Mid-size models '70 thru '83
- 14025 (Renault) Alliance & Encore '83 thru '87

AUDI

- 15020 4000 all models '80 thru '87
- 15025 5000 all models '77 thru '83
- 15026 5000 all models '84 thru '88

AUSTIN-HEALEY

- Sprite - see MG Midget (68015)

BMW

- *18020 3/5 Series not including diesel or all-wheel drive models '82 thru '92
- 18021 3-Series incl. Z3 models '92 thru '98
- 18025 320i all 4 cyl models '75 thru '83
- 18050 1500 thru 2002 except Turbo '59 thru '77

BUICK

- *19010 Buick Century '97 thru '02
- Century (front-wheel drive) - see GM (38005)
- *19020 Buick, Oldsmobile & Pontiac Full-size (Front-wheel drive) '85 thru '02
- Buick Electra, LeSabre and Park Avenue; Oldsmobile Delta 88 Royale, Ninety Eight and Regency; Pontiac Bonneville
- 19025 Buick Oldsmobile & Pontiac Full-size (Rear wheel drive)
- Buick Estate '70 thru '90, Electra '70 thru '84, LeSabre '70 thru '85, Limited '74 thru '79
- Oldsmobile Custom Cruiser '70 thru '90, Delta 88 '70 thru '85, Ninety-eight '70 thru '84
- Pontiac Bonneville '70 thru '81, Catalina '70 thru '81, Grandville '70 thru '75, Parisienne '83 thru '86
- 19030 Mid-size Regal & Century all rear-drive models with V6, V8 and Turbo '74 thru '87
- Regal - see GENERAL MOTORS (38010)
- Riviera - see GENERAL MOTORS (38030)
- Roadmaster - see CHEVROLET (24046)
- Skyhawk - see GENERAL MOTORS (38015)
- Skylark - see GM (38020, 38025)
- Somerset - see GM (38025)

CADILLAC

- 21030 Cadillac Rear Wheel Drive
- all gasoline models '70 thru '93
- Cimarron - see GENERAL MOTORS (38015)
- DeVille - see GM (38031 & 38032)
- Eldorado - see GM (38030 & 38031)
- Fleetwood - see GM (38031)
- Seville - see GM (38030, 38031 & 38032)

CHEVROLET

- *24010 Astro & GMC Safari Mini-vans '85 thru '02
- 24015 Camaro V8 all models '70 thru '81
- 24016 Camaro all models '82 thru '92
- 24017 Camaro & Firebird '93 thru '00
- Cavalier - see GENERAL MOTORS (38016)
- Celebrity - see GENERAL MOTORS (38005)
- 24020 Chevelle, Malibu & El Camino '69 thru '87
- 24024 Chevette & Pontiac T1000 '76 thru '87
- Citation - see GENERAL MOTORS (38020)
- 24032 Corsica/Beretta all models '87 thru '96
- 24040 Corvette all V8 models '68 thru '82
- 24041 Corvette all models '84 thru '96
- 13035 Chevrolet Engine Overhaul Manual
- 24045 Full-size Sedans Caprice, Impala, Biscayne, Bel Air & Wagons '69 thru '90
- 24046 Impala SS & Caprice and Buick Roadmaster '91 thru '96
- Impala - see LUMINA (24048)
- Lumina '90 thru '94 - see GM (38010)
- *24048 Lumina & Monte Carlo '95 thru '01
- Lumina APV - see GM (38035)
- 24050 Luv Pick-up all 2WD & 4WD '72 thru '82
- Malibu '97 thru '00 - see GM (38026)

- 24055 Monte Carlo all models '70 thru '88
- Monte Carlo '95 thru '01 - see LUMINA (24048)
- 24059 Nova all V8 models '69 thru '79
- 24060 Nova and Geo Prizm '85 thru '92
- 24064 Pick-ups '67 thru '87 - Chevrolet & GMC, all V8 & in-line 6 cyl, 2WD & 4WD '67 thru '87; Suburbans, Blazers & Jimmys '67 thru '91
- *24065 Pick-ups '88 thru '98 - Chevrolet & GMC, full-size pick-ups '88 thru '98, C/K Classic '99 & '00, Blazer & Jimmy '92 thru '94; Suburban '92 thru '99; Tahoe & Yukon '95 thru '99
- *24066 Pick-ups '99 thru '01 - Chevrolet Silverado & GMC Sierra full-size pick-ups '99 thru '01, Suburban/Tahoe/Yukon/Yukon XL '00 thru '01
- 24070 S-10 & S-15 Pick-ups '82 thru '93, Blazer & Jimmy '83 thru '94,
- *24071 S-10 & S-15 Pick-ups '94 thru '01, Blazer & Jimmy '95 thru '01, Hombre '96 thru '01
- *24072 Trailblazer & GMC Envoy '02 thru '03
- 24075 Sprint '85 thru '88 & Geo Metro '89 thru '01
- 24080 Vans - Chevrolet & GMC '68 thru '96

CHRYSLER

- 25015 Chrysler Cirrus, Dodge Stratus, Plymouth Breeze '95 thru '00
- 10310 Chrysler Engine Overhaul Manual
- 25020 Full-size Front-Wheel Drive '88 thru '93
- K-Cars - see DODGE Aries (30008)
- Laser - see DODGE Daytona (30030)
- 25025 Chrysler LHS, Concorde, New Yorker, Dodge Intrepid, Eagle Vision, '93 thru '97
- *25026 Chrysler LHS, Concorde, 300M, Dodge Intrepid, '98 thru '03
- 25030 Chrysler & Plymouth Mid-size front wheel drive '82 thru '95
- Rear-wheel Drive - see Dodge (30050)
- *25035 PT Cruiser all models '01 thru '03
- *25040 Chrysler Sebring, Dodge Stratus & Avenger '95 thru '02

DATSUN

- 28005 200SX all models '80 thru '83
- 28007 B-210 all models '73 thru '78
- 28009 210 all models '79 thru '82
- 28012 240Z, 260Z & 280Z Coupe '70 thru '78
- 28014 280ZX Coupe & 2+2 '79 thru '83
- 300ZX - see NISSAN (72010)
- 28016 310 all models '78 thru '82
- 28018 510 & PL521 Pick-up '68 thru '73
- 28020 510 all models '78 thru '81
- 28022 620 Series Pick-up all models '73 thru '79
- 720 Series Pick-up - see NISSAN (72030)
- 28025 810/Maxima all gas models, '77 thru '84

DODGE

- 400 & 600 - see CHRYSLER (25030)
- 30008 Aries & Plymouth Reliant '81 thru '89
- 30010 Caravan & Plymouth Voyager '84 thru '95
- *30011 Caravan & Plymouth Voyager '96 thru '02
- 30012 Challenger/Plymouth Saporro '78 thru '83
- 30016 Colt & Plymouth Champ '78 thru '87
- 30020 Dakota Pick-ups all models '87 thru '96
- *30021 Durango '98 & '99, Dakota '97 thru '99
- 30025 Dart, Demon, Plymouth Barracuda, Duster & Valiant 6 cyl models '67 thru '76
- 30030 Daytona & Chrysler Laser '84 thru '89
- Intrepid - see CHRYSLER (25025, 25026)
- 30034 Neon all models '95 thru '99
- 30036 Neon all models '00 thru '03
- 30035 Omni & Plymouth Horizon '78 thru '90
- 30040 Pick-ups all full-size models '74 thru '93
- *30041 Pick-ups all full-size models '94 thru '01
- 30045 Ram 50/D50 Pick-ups & Raider and Plymouth Arrow Pick-ups '79 thru '93
- 30050 Dodge/Plymouth/Chrysler RWD '71 thru '89
- 30055 Shadow & Plymouth Sundance '87 thru '94
- 30060 Spirit & Plymouth Acclaim '89 thru '95
- *30065 Vans - Dodge & Plymouth '71 thru '99

EAGLE

- Talon - see MITSUBISHI (68030, 68031)
- Vision - see CHRYSLER (25025)

FIAT

- 34010 124 Sport Coupe & Spider '68 thru '78
- 34025 X1/9 all models '74 thru '80

FORD

- 10355 Ford Automatic Transmission Overhaul
- 36004 Aerostar Mini-vans all models '86 thru '97
- 36006 Contour & Mercury Mystique '95 thru '00
- 36008 Courier Pick-up all models '72 thru '82
- *36012 Crown Victoria & Mercury Grand Marquis '88 thru '00
- 10320 Ford Engine Overhaul Manual
- 36016 Escort/Mercury Lynx all models '81 thru '90
- 36020 Escort/Mercury Tracer '91 thru '00
- 36024 Explorer & Mazda Navajo '91 thru '01
- 36028 Fairmont & Mercury Zephyr '78 thru '83
- 36030 Festiva & Aspire '88 thru '97
- 36032 Fiesta all models '77 thru '80
- *36034 Focus all models '00 and '01
- 36036 Ford & Mercury Full-size '75 thru '87
- 36040 Granada & Mercury Monarch '75 thru '80
- 36044 Ford & Mercury Mid-size '75 thru '86
- 36048 Mustang V8 all models '64-1/2 thru '73
- 36049 Mustang II 4 cyl, V6 & V8 models '74 thru '78
- 36050 Mustang & Mercury Capri all models Mustang, '79 thru '93; Capri, '79 thru '86
- *36051 Mustang all models '94 thru '00
- 36054 Pick-ups & Bronco '73 thru '79
- 36058 Pick-ups & Bronco '80 thru '96
- *36059 F-150 & Expedition '97 thru '02, F-250 '97 thru '99 & Lincoln Navigator '98 thru '02
- *36060 Super Duty Pick-ups, Excursion '97 thru '02
- 36062 Pinto & Mercury Bobcat '75 thru '80
- 36066 Probe all models '89 thru '92
- 36070 Ranger/Bronco II gas models '83 thru '92
- *36071 Ranger '93 thru '00 & Mazda Pick-ups '94 thru '00
- 36074 Taurus & Mercury Sable '86 thru '95
- *36075 Taurus & Mercury Sable '96 thru '01
- 36078 Tempo & Mercury Topaz '84 thru '94
- 36082 Thunderbird/Mercury Cougar '83 thru '88
- 36086 Thunderbird/Mercury Cougar '89 and '97
- 36090 Vans all V8 Econoline models '69 thru '91
- *36094 Vans full size '92 thru '01
- *36097 Windstar Mini-van '95 thru '01

GENERAL MOTORS

- 10360 GM Automatic Transmission Overhaul
- 38005 Buick Century, Chevrolet Celebrity, Oldsmobile Cutlass Ciera & Pontiac 6000 all models '82 thru '96
- *38010 Buick Regal, Chevrolet Lumina, Oldsmobile Cutlass Supreme & Pontiac Grand Prix (FWD) '88 thru '02
- 38015 Buick Skyhawk, Cadillac Cimarron, Chevrolet Cavalier, Oldsmobile Firenza & Pontiac J-2000 & Sunbird '82 thru '94
- *38016 Chevrolet Cavalier & Pontiac Sunfire '95 thru '00
- 38020 Buick Skylark, Chevrolet Citation, Olds Omega, Pontiac Phoenix '80 thru '85
- 38025 Buick Skylark & Somerset, Oldsmobile Achieva & Calais and Pontiac Grand Am all models '85 thru '98
- *38026 Chevrolet Malibu, Olds Alero & Cutlass, Pontiac Grand Am '97 thru '00
- 38030 Cadillac Eldorado '71 thru '85, Seville '80 thru '85, Oldsmobile Toronado '71 thru '85, Buick Riviera '79 thru '85
- *38031 Cadillac Eldorado & Seville '86 thru '91, DeVille '86 thru '93, Fleetwood & Olds Toronado '86 thru '92, Buick Riviera '86 thru '93
- 38032 Cadillac DeVille '94 thru '02 & Seville '92 thru '02
- 38035 Chevrolet Lumina APV, Olds Silhouette & Pontiac Trans Sport all models '90 thru '95
- *38036 Chevrolet Venture, Olds Silhouette, Pontiac Trans Sport & Montana '97 thru '01
- General Motors Full-size Rear-wheel Drive - see BUICK (19025)



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HAYNES REPAIR MANUALS

GEO

Metro - see **CHEVROLET Sprint** (24075)
Prizm - '85 thru '92 see **CHEVY** (24060),
'93 thru '02 see **TOYOTA Corolla** (92036)
40030 Storm all models '90 thru '93
Tracker - see **SUZUKI Samurai** (90010)

GMC

Vans & Pick-ups - see **CHEVROLET**

HONDA

42010 Accord CVCC all models '76 thru '83
42011 Accord all models '84 thru '89
42012 Accord all models '90 thru '93
42013 Accord all models '94 thru '97
42014 Accord all models '98 and '99
42020 Civic 1200 all models '73 thru '79
42021 Civic 1300 & 1500 CVCC '80 thru '83
42022 Civic 1500 CVCC all models '75 thru '79
42023 Civic all models '84 thru '91
42024 Civic & del Sol '92 thru '95
42025 Civic '96 thru '00, CR-V '97 thru '00,
Acura Integra '94 thru '00
42040 Prelude CVCC all models '79 thru '89

HYUNDAI

*43010 Elantra all models '96 thru '01
43015 Excel & Accent all models '86 thru '98

ISUZU

Hombre - see **CHEVROLET S-10** (24071)
*47017 Rodeo '91 thru '02; Amigo '89 thru '94 and
'98 thru '02; Honda Passport '95 thru '02
47020 Trooper & Pick-up '81 thru '93

JAGUAR

49010 XJ6 all 6 cyl models '68 thru '86
49011 XJ6 all models '88 thru '94
49015 XJ12 & XJS all 12 cyl models '72 thru '85

JEEP

50010 Cherokee, Comanche & Wagoneer Limited
all models '84 thru '00
50020 CJ all models '49 thru '86
*50025 Grand Cherokee all models '93 thru '00
50029 Grand Wagoneer & Pick-up '72 thru '91
Grand Wagoneer '84 thru '91, Cherokee &
Wagoneer '72 thru '83, Pick-up '72 thru '88
*50030 Wrangler all models '87 thru '00

LEXUS

ES 300 - see **TOYOTA Camry** (92007)

LINCOLN

Navigator - see **FORD Pick-up** (36059)
*59010 Rear-Wheel Drive all models '70 thru '01

MAZDA

61010 GLC Hatchback (rear-wheel drive) '77 thru '83
61011 GLC (front-wheel drive) '81 thru '85
61015 323 & Protégé '90 thru '00
*61016 MX-5 Miata '90 thru '97
61020 MPV all models '89 thru '94
Navajo - see **Ford Explorer** (36024)
61030 Pick-ups '72 thru '93
Pick-ups '94 thru '00 - see **Ford Ranger** (36071)
61035 RX-7 all models '79 thru '85
61036 RX-7 all models '86 thru '91
61040 626 (rear-wheel drive) all models '79 thru '82
61041 626/MX-6 (front-wheel drive) '83 thru '91
61042 626 '93 thru '01, MX-6/Ford Probe '93 thru '97

MERCEDES-BENZ

63012 123 Series Diesel '76 thru '85
63015 190 Series four-cyl gas models, '84 thru '88
63020 230/250/280 6 cyl sohc models '68 thru '72
63025 280 123 Series gasoline models '77 thru '81
63030 350 & 450 all models '71 thru '80

MERCURY

64200 Villager & Nissan Quest '93 thru '01
All other titles, see **FORD Listing**.

MG

66010 MGB Roadster & GT Coupe '62 thru '80
66015 MG Midget, Austin Healey Sprite '58 thru '80

MITSUBISHI

68020 Cordia, Tredia, Galant, Precis &
Mirage '83 thru '93
68030 Eclipse, Eagle Talon & Ply. Laser '90 thru '94
*68031 Eclipse '95 thru '01, Eagle Talon '95 thru '98
*68035 Galant '94 thru '02
68040 Pick-up '83 thru '96 & Montero '83 thru '93

NISSAN

72010 300ZX all models including Turbo '84 thru '89
72015 Altima all models '93 thru '01
72020 Maxima all models '85 thru '92
72021 Maxima all models '93 thru '01
72030 Pick-ups '80 thru '97 Pathfinder '87 thru '95
*72031 Frontier Pick-up '98 thru '01, Xterra '00 & '01,
Pathfinder '96 thru '01
72040 Pulsar all models '83 thru '86
Quest - see **MERCURY Villager** (64200)
72050 Sentra all models '82 thru '94
72051 Sentra & 200SX all models '95 thru '99
72060 Stanza all models '82 thru '90

OLDSMOBILE

73015 Cutlass V6 & V8 gas models '74 thru '88
For other **OLDSMOBILE** titles, see **BUICK**,
CHEVROLET or **GENERAL MOTORS** listing.

PLYMOUTH

For **PLYMOUTH** titles, see **DODGE** listing.

PONTIAC

79008 Fiero all models '84 thru '88
79018 Firebird V8 models except Turbo '70 thru '81
79019 Firebird all models '82 thru '92
79040 Mid-size Rear-wheel Drive '70 thru '87

For other **PONTIAC** titles, see **BUICK**,
CHEVROLET or **GENERAL MOTORS** listing.

PORSCHE

80020 911 except Turbo & Carrera 4 '65 thru '89
80025 914 all 4 cyl models '69 thru '76
80030 924 all models including Turbo '76 thru '82
80035 944 all models including Turbo '83 thru '89

RENAULT

Alliance & Encore - see **AMC** (14020)

SAAB

*84010 900 all models including Turbo '79 thru '88

SATURN

*87010 Saturn all models '91 thru '99

SUBARU

89002 1100, 1300, 1400 & 1600 '71 thru '79
89003 1600 & 1800 2WD & 4WD '80 thru '94

SUZUKI

90010 Samurai/Sidekick & Geo Tracker '86 thru '01

TOYOTA

92005 Camry all models '83 thru '91
92006 Camry all models '92 thru '96
*92007 Camry, Avalon, Solara, Lexus ES 300 '97 thru '01
92015 Celica Rear Wheel Drive '71 thru '85
92020 Celica Front Wheel Drive '86 thru '99
92025 Celica Supra all models '79 thru '92
92030 Corolla all models '75 thru '79
92032 Corolla all rear wheel drive models '80 thru '87
92035 Corolla all front wheel drive models '84 thru '92
92036 Corolla & Geo Prizm '93 thru '02
92040 Corolla Tercel all models '80 thru '82
92045 Corona all models '74 thru '82
92050 Cressida all models '78 thru '82
92055 Land Cruiser FJ40, 43, 45, 55 '68 thru '82
92056 Land Cruiser FJ60, 62, 80, FZJ80 '80 thru '96
92065 MR2 all models '85 thru '87
92070 Pick-up all models '69 thru '78
92075 Pick-up all models '79 thru '95
*92076 Tacoma '95 thru '00, 4Runner '96 thru '00,
& T100 '93 thru '98
*92078 Tundra '00 thru '02 & Sequoia '01 thru '02
92080 Previa all models '91 thru '95
*92082 RAV4 all models '96 thru '02
92085 Tercel all models '87 thru '94

92085 Tercel all models '87 thru '94
92090 Sienna Van all models '98 thru '02

TRIUMPH

94007 Spitfire all models '62 thru '81
94010 TR7 all models '75 thru '81

VW

96008 Beetle & Karmann Ghia '54 thru '79
*96009 New Beetle '98 thru '00
96016 Rabbit, Jetta, Scirocco & Pick-up gas
models '74 thru '91 & Convertible '80 thru '92
96017 Golf, GTI & Jetta '93 thru '98
& Cabrio '95 thru '98
*96018 Golf, GTI, Jetta & Cabrio '99 thru '02
96020 Rabbit, Jetta & Pick-up diesel '77 thru '84
96023 Passat '98 thru '01, Audi A4 '96 thru '01
96030 Transporter 1600 all models '68 thru '79
96035 Transporter 1700, 1800 & 2000 '72 thru '79
96040 Type 3 1500 & 1600 all models '63 thru '73
96045 Vanagon all air-cooled models '80 thru '83

VOLVO

97010 120, 130 Series & 1800 Sports '61 thru '73
97015 140 Series all models '66 thru '74
97020 240 Series all models '76 thru '93
97040 740 & 760 Series all models '82 thru '88
97050 850 Series all models '93 thru '97

TECHBOOK MANUALS

10205 Automotive Computer Codes
10210 Automotive Emissions Control Manual
10215 Fuel Injection Manual, 1978 thru 1985
10220 Fuel Injection Manual, 1986 thru 1999
10225 Holley Carburetor Manual
10230 Rochester Carburetor Manual
10240 Weber/Zenith/Stromberg/SU Carburetors
10305 Chevrolet Engine Overhaul Manual
10310 Chrysler Engine Overhaul Manual
10320 Ford Engine Overhaul Manual
10330 GM & Ford Diesel Engine Repair Manual
10340 Small Engine Repair Manual, 5 HP & Less
10341 Small Engine Repair Manual, 5.5 - 20 HP
10345 Suspension, Steering & Driveline Manual
10355 Ford Automatic Transmission Overhaul
10360 GM Automatic Transmission Overhaul
10405 Automotive Body Repair & Painting
10410 Automotive Brake Manual
10411 Automotive Anti-lock Brake (ABS) Systems
10415 Automotive Detailing Manual
10420 Automotive Electrical Manual
10425 Automotive Heating & Air Conditioning
10430 Automotive Reference Manual & Dictionary
10435 Automotive Tools Manual
10440 Used Car Buying Guide
10445 Welding Manual
10450 ATV Basics

SPANISH MANUALS

98903 Reparación de Carrocería & Pintura
98905 Códigos Automotrices de la Computadora
98910 Frenos Automotriz
98915 Inyección de Combustible 1986 al 1999
99040 Chevrolet & GMC Camionetas '67 al '91
Incluye Suburban, Blazer & Jimmy '67 al '91
99041 Chevrolet & GMC Camionetas '88 al '98
Incluye Suburban '92 al '98, Blazer &
Jimmy '92 al '94, Tahoe & Yukon '95 al '98
99042 Chevrolet & GMC Camionetas
Cerradas '68 al '95
99055 Dodge Caravan & Plymouth Voyager '84 al '95
99075 Ford Camionetas y Bronco '80 al '94
99077 Ford Camionetas Cerradas '69 al '91
99083 Ford Modelos de Tamaño Grande '75 al '87
99088 Ford Modelos de Tamaño Mediano '75 al '86
99091 Ford Taurus & Mercury Sable '86 al '95
99095 GM Modelos de Tamaño Grande '70 al '90
99100 GM Modelos de Tamaño Mediano '70 al '88
99110 Nissan Camioneta '80 al '96, Pathfinder '87 al '95
99118 Nissan Sentra '82 al '94
99125 Toyota Camionetas
y 4Runner '79 al '95

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E In-car Entertainment

Haynes - publishers of the best automotive manuals for repairing your vehicle - now offers the same easy-to-follow, step-by-step process for customizing your ride. Everything from adding a powerful sound system to installing a complete video entertainment center can be found in this comprehensive book. And since it's from Haynes, it's easy to do-it-yourself!

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- in-dash players
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- exotic speaker installations
- subwoofers and enclosures
- powerful amps
- satellite radio upgrade
- headrest video monitors
- complete in-car video system
- in-dash navigation
- car alarms
- and much, much more



Choosing the right amp

The first step is to determine the needs of your system. If you're just adding an amp to improve your original equipment system, you may need only minimal amplification. Therefore, a small inexpensive amp will suffice. On the other hand, if you're planning on running multiple subwoofers and component speakers, you'll most likely need multiple amplifiers.

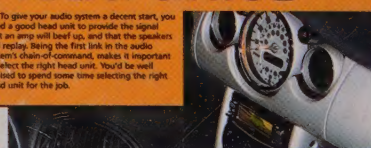
Next, you have to figure out if you need an amplifier with a built-in processor or an amp that is dedicated to playing a full-range signal. A built-in processor can cross over different frequencies dedicated to a particular speaker whereas a 12-ohm subwoofer will handle bass playing 100Hz and down. This will maximize the sound the speaker plays in the frequency range.



Head units

To give your audio system a decent start, you need a good head unit to provide the signal that an amp will beef up, and that the speakers will replay. Being the first link in the audio system's chain-of-command, makes it important to select the right head unit. You'd be well advised to spend some time selecting the right head unit for the job.

Some factory head units require removal keys. Check the Haynes manual for your vehicle for the correct removal procedure.



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